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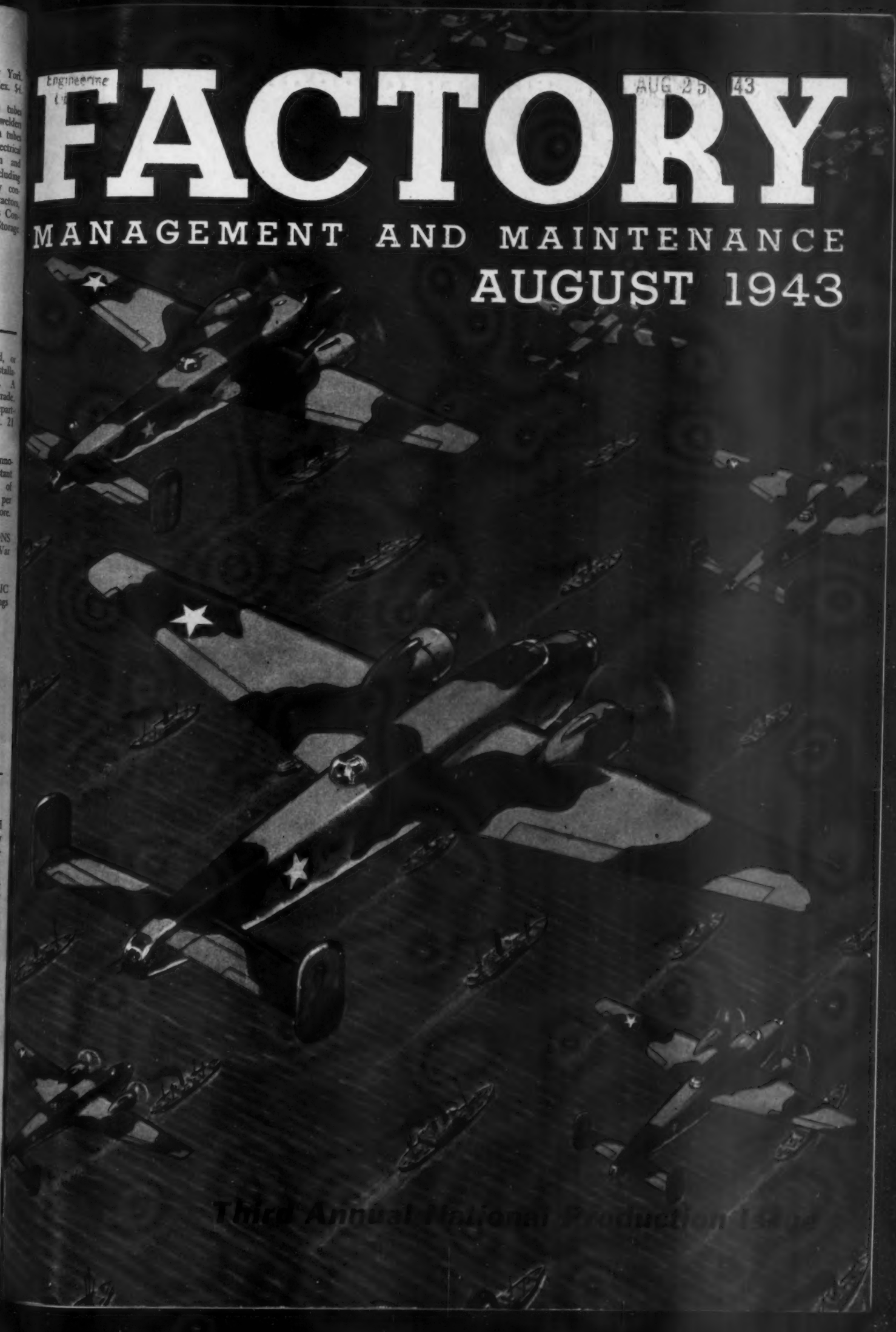
# FACTORY

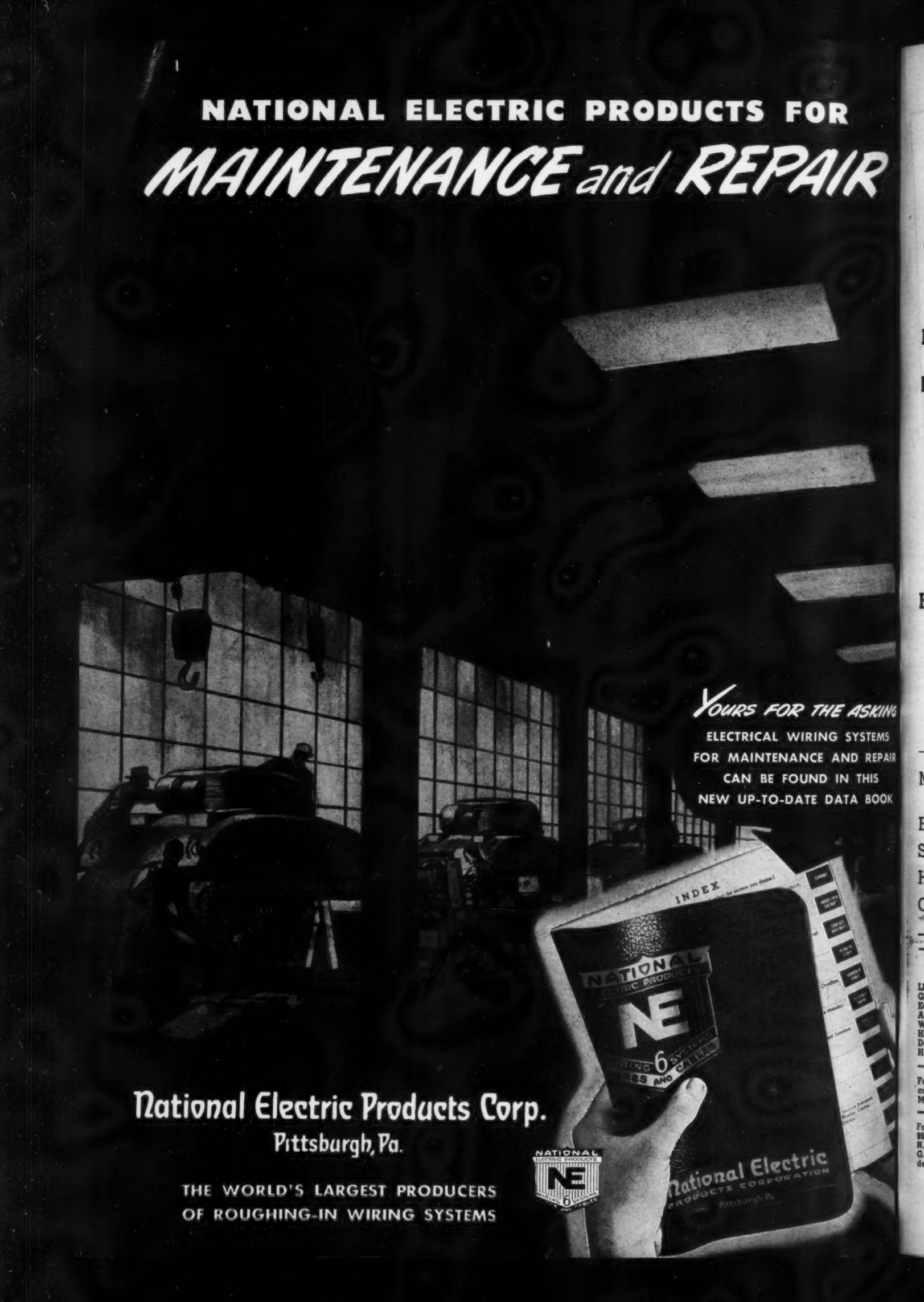
## MANAGEMENT AND MAINTENANCE

AUGUST 1943



Third Annual National Production Issue

# NATIONAL ELECTRIC PRODUCTS FOR *MAINTENANCE and REPAIR*



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# FACTORY

## MANAGEMENT AND MAINTENANCE

THIRD ANNUAL NATIONAL PRODUCTION ISSUE

**AUGUST · 1943**


**Production for War and Post-War** ..... 81

**How to Make the Most Effective Use of Manpower** ..... 87–144

Step 1—Employ Modern Recruiting Procedures ..... 88
Step 2—Use the Right Selection and Testing Methods ..... 96
Step 3—Adopt Tested Training Systems ..... 106
Step 4—Apply Incentives That Will Get Production ..... 116
Step 5—Benefit From Labor-Management Cooperation ..... 124
Step 6—Carry On Health and Safety Activities ..... 134

**How to Make the Most Effective Use of Equipment** ..... 145–184

Step 1—Select Layout and Handling That Suit Your Product ..... 146
Step 2—Find the One Best Way of Manufacture ..... 154
Step 3—Use Effective Production Control ..... 164
Step 4—Maintain Machines and Services for Continuous Operation ..... 174

Management—Heart of America's Industrial Progress ..... *James H. McGraw, Jr.* *preceding page* 81

Equipment News ..... 186
Significant Labor Developments ..... 246
How Three War Plants Train Women ..... 300
Calendar ..... 328
You Want to Know ..... 232
They Say and Do ..... 270
Books ..... 324
Catalog Service ..... 238



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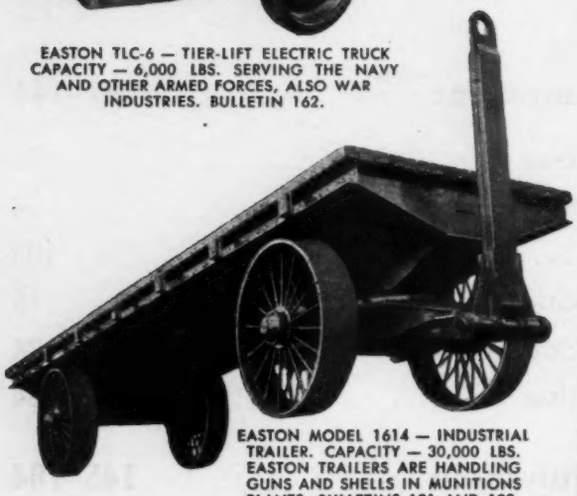
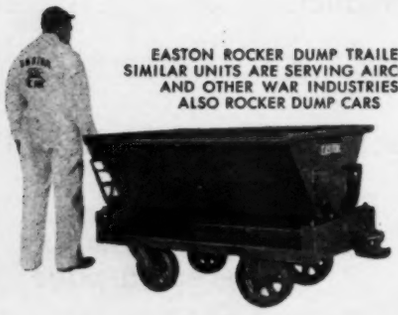


EASTON MODEL 1614 — INDUSTRIAL TRAILER. CAPACITY — 30,000 LBS. EASTON TRAILERS ARE HANDLING GUNS AND SHELLS IN MUNITIONS PLANTS. BULLETINS 191 AND 192.



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# Management
# —Heart of America's Industrial Progress

## *In Peace and War, Management Men and Methods Steer Production on a Steady Upward Course*

WHEN the Allied armada of 2,000 ships, protected by a vast umbrella of planes, struck the coast of Sicily, Axis leaders once more had reason to wonder how "that decadent, pleasure-loving America" had swung from the manufacture of automobiles, refrigerators and costume jewelry to equipments of war, and had out-produced such mighty plants as the Krupp, the Fiat and the Skoda works — and had done it so quickly.

America at war is in the lead just as it has led a world at peace. Super-performing planes are taking to the air at the present rate of nearly 100,000 per year. Ships, to carry the war to our enemies, slide down the ways at the rate of two a day. Tanks, trucks, guns, ammunition are pouring out of our "peace" plants in far greater volume than the entire Axis effort can possibly equal. War expenditures in 1943 alone will reach the staggering figure of approximately $83,000,000,000 — an amount equal to our entire national income for 1929. Added to this is the rock-bottom output of essential civilian goods — a very considerable item.

This unprecedented production is taking place while some 9,000,000 men and women, those physically best equipped, have been called to the armed forces. Many of them were taken from industry, and their loss could be repaired only by more efficient equipment and more effective methods.

Rigorous training programs had to be superimposed upon many other abnormal problems facing industry in its high-speed conversion from stoves to boats; from printing machines to guns; from automobiles to airplane engines; from fishing tackle to bomb sights.

This phenomenal task was further complicated by the need for rapid expansion. A modest machine tool industry had to be expanded to handle a volume many times its normal capacity. Steel production had to be increased by 20%, and that of aluminum and magnesium multiplied over and over. From almost nil, the demand for high octane gasoline soared to unbelievable quantities. The creation of synthetic rubber and electronic industries was necessary almost overnight.

Who deserves credit for these accomplishments? All industry! The engineers, chemists, designers, skilled workers, common laborers. But over and above all it belongs to *management.*

In industry it is mandatory to have a directive force to co-ordinate the efforts of men in the use of materials and the application of power toward the production of goods and services. The application of this directive force is the function of management, and only because we had today's kind of management were we able to transform ourselves, almost overnight, from a peace-loving nation to the world's greatest producer of implements of war. As a nation, we had been preparing for a long time to play our part in world affairs. This preparation, certainly not planned for today's objectives but none the less effective, began some four decades ago.

With the advent of the twentieth century, the character of industry in the United States, and, therefore, the character of American living, began to change. Scientific management was born. Frederick W. Taylor brought into focus and showed how to use effectively those processes and procedures upon which our present-day mass production is based. He was followed by Harrington Emerson, who made the industrial world acquainted with efficiency in manufacture and the remarkable progress to be gained therefrom in the field of production, with its consequent price reductions and wider distribution of industry's products. There followed, in industry, an alert management, a capable management, a management with vision. Without it, the work of Taylor and Emerson would have gone for naught.

It is because of this early work of management — and the extraordinary developments it produced — that the country as a whole, and particularly those employed in industry, were not over-awed by the seemingly impossible job of quick conversion to all-out war production. But let us look back four decades and examine some of those preparatory accomplishments which have proven so vital to the progress and welfare of the nation.

From 1900 to 1939 (the last pre-war year), total employment of all kinds increased 52 per cent; in the manufacturing industries alone the increase was 84 per cent. *The nation became definitely industrial.*

In 1900 the average wage earner was able to spend only 20.2 per cent of his income for things other than necessities; in 1930 his buying power for non-essentials had increased to 34.8 per cent. *The average man acquired confidence in what industry could do.*

In 1900 the average work week was 56 hours; in 1930 it was 48 hours. *The burden of production was being transferred from man to machine.*

In 1939 the United States possessed 30 per cent of the world's railroads, 72 per cent of its automobiles, 49 per cent of its telephones. *The nation's production equipment had grown to formidable proportions.*

In 1939 nearly half of the families in the United States owned their own homes, 64 million individuals carried life insurance policies and 45 million had savings accounts. National income had increased 300 per cent from 1900 and during the same period the proportion of national income paid out in salaries and wages increased from 58 to 70 per cent. And in less than this period (1914–1939) the purchasing power of the wage rate increased by 60 per cent. *There had been evolved the kind of living for which men will work — and fight.*

Since 1900, factories increased their output of goods from $11,000,000,000 to $60,000,000,000 in 1939. This increase of nearly 450 per cent was accomplished while the country's population rose only 60 per cent. In this same span of years, technological developments and improvements in methods had

increased the value added by manufacture per wage earner by 200 per cent, and the horsepower per factory worker had been multiplied by 2½. *The nation's production plant was ready to assume its gigantic wartime job.*

During this period of industrial and national evolution, management itself had changed. Prior to the advent of scientific management, our goods and services were the product of several kinds of directive activities, varying from the strictly paternalistic to the ruthless. There was little conception of the responsibility that industry now broadly acknowledges — the responsibility of trusteeship in the interest of stockholders, employees and the public — specifically; in the interest of our national economy — generally. Acceptance of this stewardship is acceptance, also, of the belief that, in the long run, no industry, and no unit of industry, that does not serve society can live.

Have the actions of management caused the times to change? Or has an alert management been successful only because it has changed with the times? Certainly, the industrial concern of 1900 would not thrive under the conditions of today. Just as certainly the new things that industry has in store for a waiting postwar world will have a far-reaching effect upon the times.

Management today seldom owns the factory or the business it manages. It is hired to perform the coordinating, directive functions. It is free to change — of itself, or with the times. Management therefore exercises its power through leadership in executing ideas . . . not through ownership.

***This is the fourteenth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.***

Good management can be sustained only in an environment sympathetic to its aims. It has an undeniable obligation to society, because it must be a compatible part of the social structure or be rejected by that structure as a whole.

An environment sympathetic to its aims means, also, that industry, in the very serious reconstruction period ahead, will not be at full effectiveness if it is subjected to attacks by government no matter what the underlying reasons may be — over-zealous devotion to a cause, lack of understanding or just plain politics. It was to industry — to industrial management — that the government turned when our existence as a free nation was threatened; it is to industrial management that government must turn in order to win the peace.

This statement is made in the sincere conviction that what has made America strong is industry's ability to produce consistently more and more goods and services for more and more people. It is only by actually creating them that we built up our stockpiles of the necessities of life. And it is only by creating them that we can have more of those things that make life worth while. These become available to more people as industry succeeds in getting greater output of goods and services for a given input of human energy, materials and power.

And what of the physical jobs ahead? In this country alone, there will be an immense demand upon industry to supply the things people have been unable to purchase during the war. Today the nation is wearing out not only its automobiles, refrigerators, vacuum cleaners and radios, but its very houses, its roads, railroads, and airline equipment. It is saving its money while whetting its appetite. Truly, the calls the American people will make upon industry in the postwar period will be many and insistent.

This demand can be viewed in another light. Economists say there will be 56,000,000 persons seeking gainful employment after the war. The Committee for Economic Development has estimated that $140,000,000,000 worth of goods and services will be required each year for those people. Compare that with our actual output of $97,000,000,000 worth of goods and services in 1940 when gainful employment was 46,000,000.

These future jobs will be done if industry's management is not too much hampered by government management. Management in industry performs its function in the field of *doing* things. Management in government performs its function in the field of *regulating* things. The best cooperation of the two kinds of management will be necessary in the postwar period. Certainly, too much of the regulatory kind will interfere seriously with the kind that does things.

Industrial management must improve, too. If it is too selfish, if it does not recognize definitely the trusteeship inherent in its job, if it does not understand and live up to its social responsibilities, then it will be risking all for which we are fighting. The following suggestions are made to indicate the direction that management's self-improvement can take.

Evolution in management has been too slow in some respects. Management in industry has been too prone to see the advantages in technological development while being blind to its evils. Looking at industry and social progress as a whole, there can be no doubt as to the value of technological improvement. It creates jobs. It elevates the standard of living. But that economic fact is of no satisfaction to the individual who loses his job because a new machine or a new method required one less man. By and large, this is an evil that management can do something about.

Management has been too careless of its opportunities with regard to labor. On that account the pendulum of social readjustment has swung too far. Labor has been given extensive privilege without corresponding responsibility.

Industrial management has been too slow to abandon its policy of letting the buyer beware. As a result of this, industry today is over-regulated.

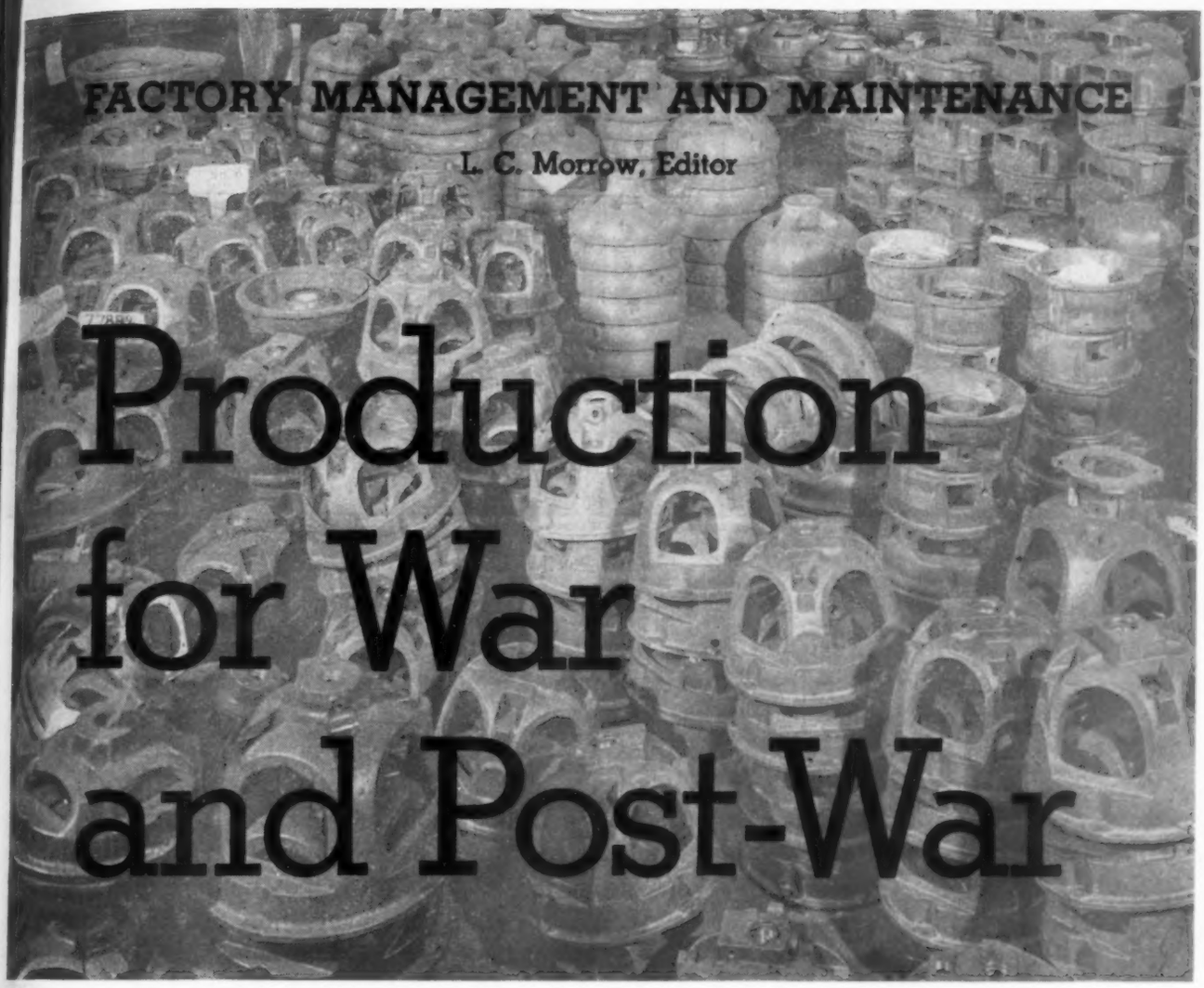
Management has been too slow in recognizing its responsibility to promote the economic philosophy that a society cannot have for consumption what it does not produce. A companion educational item too long neglected is management's obligation in the field of public relations.

In these years since 1900, industrial management has been growing. Perhaps many of its experiences have been but growing pains. Management has learned, among other things, the absolutely vital need for capital at the right time and in the right amount. It has learned to use some of its earnings as "seed-money" in the introduction of new products and the use of new processes. It has learned to invest more and more in research. It has learned of the interdependence of industry and agriculture. And it has learned much about the eternal triangle of industry, labor and government.

With such a history and such experiences behind it, I have every faith that management is going ahead to even more glorious accomplishments in the winning of the war, and I believe that its peacetime accomplishments to come are beyond the prediction of any of us — even management itself.

James H. McGraw, Jr.

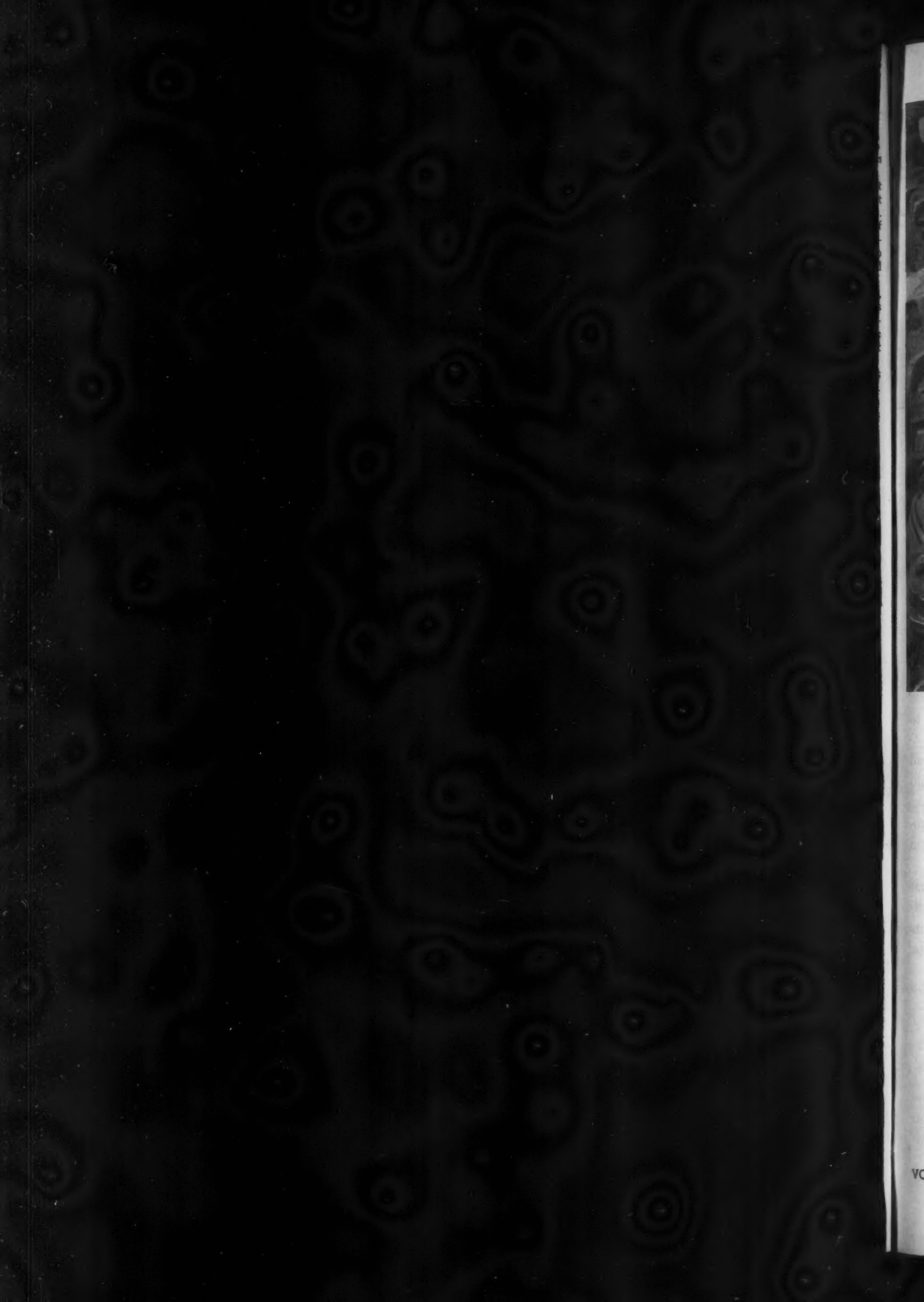
*President, McGraw-Hill Publishing Company, Inc.*

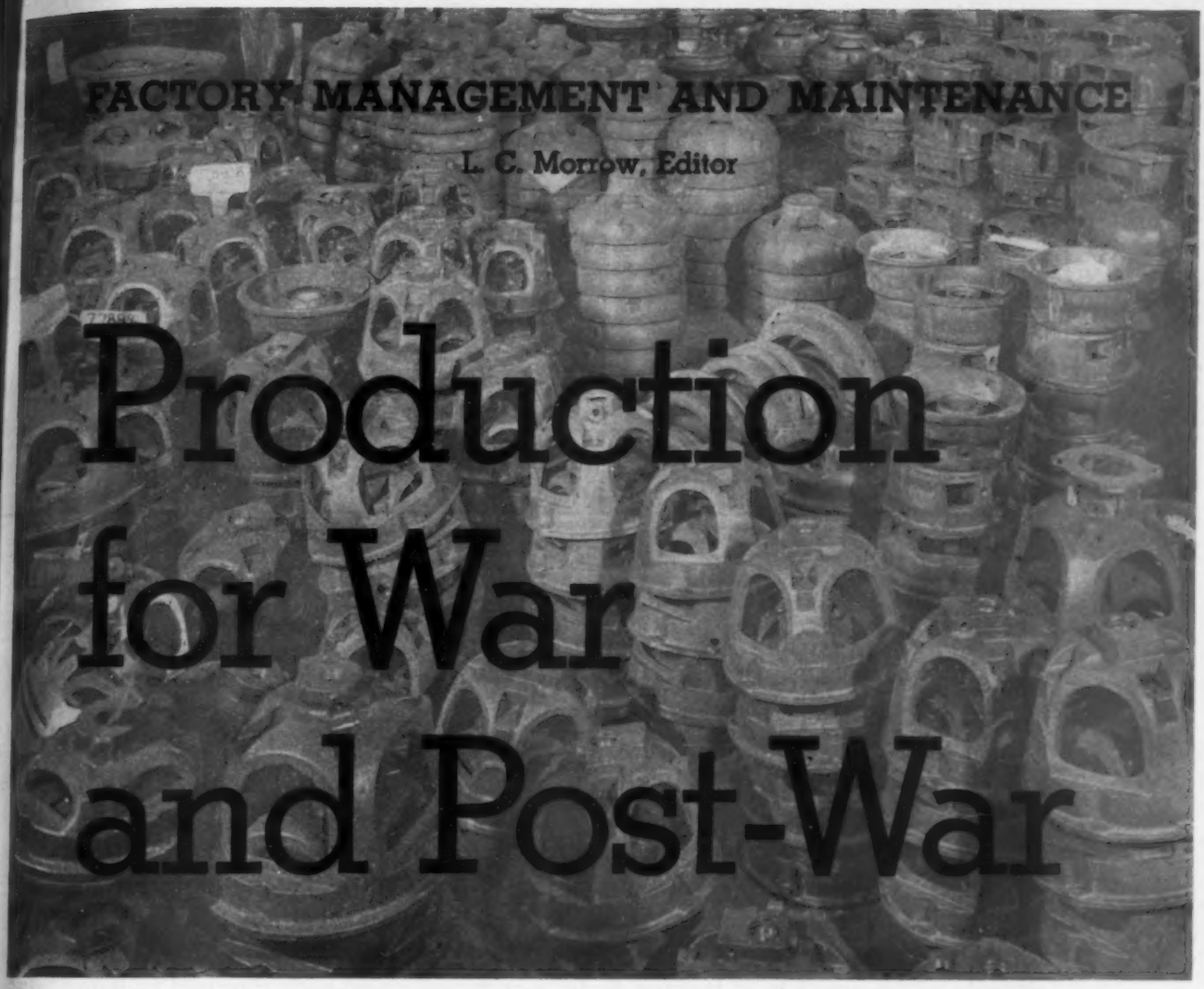



THIS THIRD NATIONAL PRODUCTION ISSUE of *Factory* takes into account post-war production—something that the first two did not. It does not propose post-war production planning to the neglect of win-the-war activities, but it does propose that industry recognize how conditions are different during this third year of war production, and that the differences demand preparation for after-the-war production.

When this peace-loving country was first thrust into the sudden need for production of the implements of war in unheard-of quantities, there could be only one attitude —get the production at any cost. That attitude prevailed in 1941, when our first National Production Issue was published. The nation had to act, almost without regard to cost in dollars, in materials, and in manpower, to get every available piece of equipment to work, and to work it around the clock seven days a week.

One year later, production had advanced so far that the emphasis had to be shifted from production-at-any-cost to production-with-partial-economy. Our rate of production made it necessary to conserve materials and manpower, and to get the most life out of equipment. The need for conservation of materials had been brought about as a result of military reverses as well as the expanded production program. Manpower problems had been accentuated by increases in the armed forces. Men for these forces had to be taken from industry, and women substituted. Additional replacements had to come from the ranks of older people and the partly incapacitated. Jobs had to be



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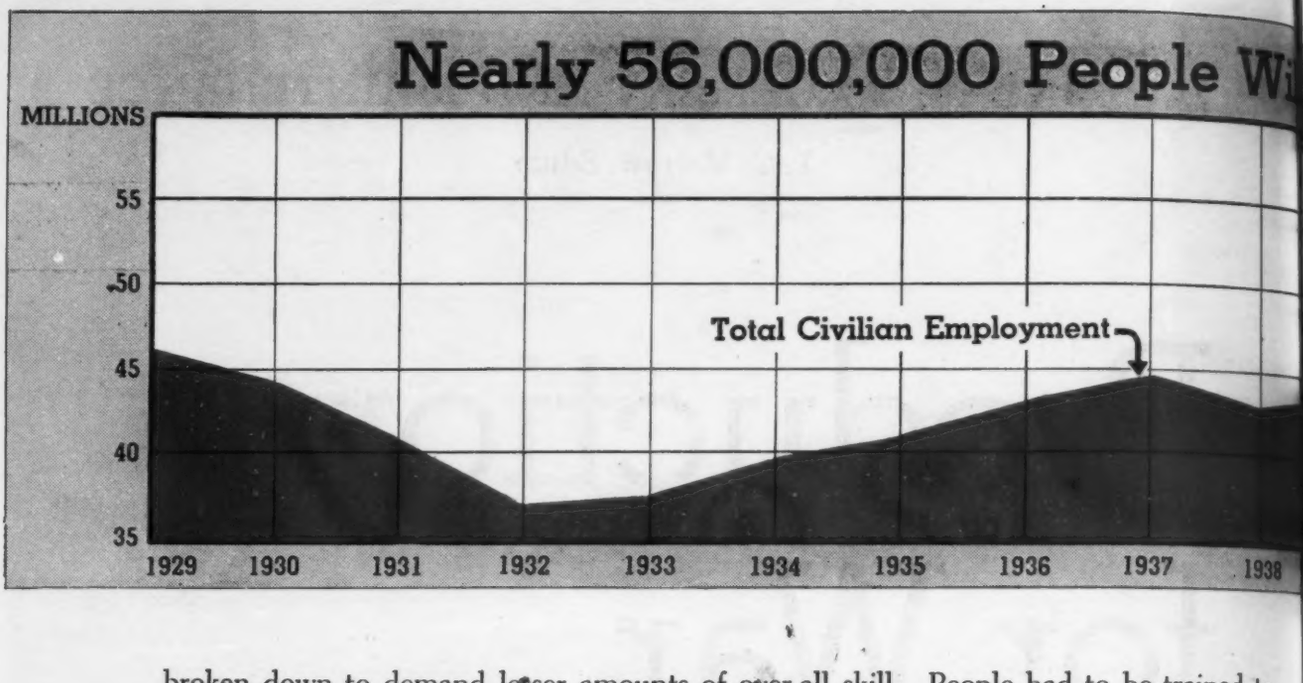



broken down to demand lesser amounts of over-all skill. People had to be trained to take on more difficult tasks on short notice or no notice. The second year's job was, indeed, quite different from the first.

In this year of 1943, our third war year, the national production task has again changed. There is the beginning of a national consciousness that this is true. The change is brought about by the fact that the nation can see ahead to the point where the war will be won. What then? Instead of weapons, what will be made? How much of it will be disposable? Who will buy it? Where will the competition be?

In the background of this consciousness is the recognition that some day the whole world, if it is to enjoy a standard of living comparable to ours, must become as efficient as we are. Or, if there is to be a common world-wide standard of living, and it turns out to be lower than the one we are accustomed to enjoy, ours will have to go down to meet it.

It is an entrancing thought that there should be a very high standard of living all over the world, with the peoples of all countries so well possessed that they would have thought for nothing but further progress, with war no part of the procedure. Each nation would produce for itself and for other nations those things it could produce with the least input of human energy, materials, and power. There would be a well-ordered exchange, with universal national and individual security.

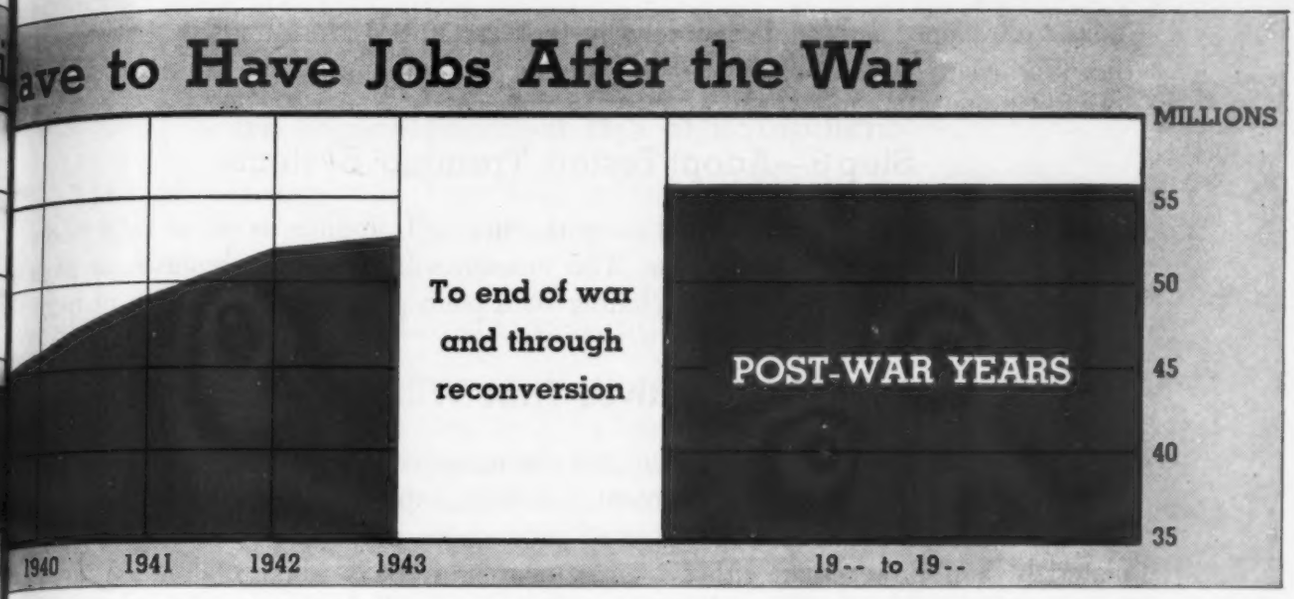
Whenever this Utopia arrives, it will have come about by reason of the fact that a great majority of the nations have carried on a keen competition in the interest of self-advancement. Step by step, as first one nation and then the other advances over its fellows, the whole world will advance. As in industry, the level of the whole will be raised as the individual units advance.

Internationally, nationally, individually, progress is going to depend upon

## Making the Most Effective Use of Manpower

## Making the Most Effective Use of Equipment

This is true whether the objective is producing implements of war or peacetime goods. Until a hundred years ago, mankind had practically nothing. Then, as man developed industry, he acquired things to make him comfortable—to supply him with




"Civilian employed" in 1946 (which we use as the available manpower in the post-war period) is estimated by the Department of Commerce on the basis of an increase of 2½ million persons in the labor force, the return of most women to private life, and armed forces of 2,000,000. It is the potential capacity of the available "civilian employed" that is represented on the other chart (pages 84 and 85) as $142,000,000,000

the three necessities of life—food, clothing, and shelter. He did this by making better and better use of his own energies, and by constantly increasing the amount of work done for him by equipment.

The post-war obligation of the plant operating personnel of the manufacturing industries is great, yet it divides itself naturally into relatively small components, related definitely to functions, so that the job of the individual plant operating executive is fairly distinct. The function of production entails the obligation of taking certain steps in order to achieve the objectives in the use of manpower and equipment:

## To Make the Most Effective Use of Manpower

the plant operating executives must first acquire that manpower. This means that they have to get potential workers to the plant. To do so, they must recognize the sources from which workers will come; get the attention of these prospects; then do a job of inducing them to go to work. In doing so, they will be taking

### Step 1—Employ Modern Recruiting Procedures

Then, by means of pre-selection, intelligence, aptitude, and dexterity tests, people must be chosen from these potential workers to fill available jobs. The emphasis will be upon fitting the applicants to jobs rather than deciding whether or not they will be given jobs at all. This procedure is

### Step 2—Use the Right Selection and Testing Methods

People having been chosen to work, they must be taught how to do the jobs for which selected. They may be trained on the job, or sent to educational institutions for refresher courses, or taught in cooperation with the public schools. For people already holding jobs, upgrading practices may be followed in order to take advantage of experience and to reward for service. Full use may be made of the three kinds of

training developed and applied widely by the Training-Within-Industry Division of the War Manpower Commission—Job Instructor Training, Job Methods Training, Job Relations Training. That is, take

## Step 3—Adopt Tested Training Systems

After people have been trained to work, they will produce in direct ratio to the incentives that are held out to them. The incentives may be wage bonuses, or profit sharing, or other kinds of awards, including both plain and fancy recognition of merit. This training procedure constitutes

## Step 4—Apply Incentives That Will Get Production

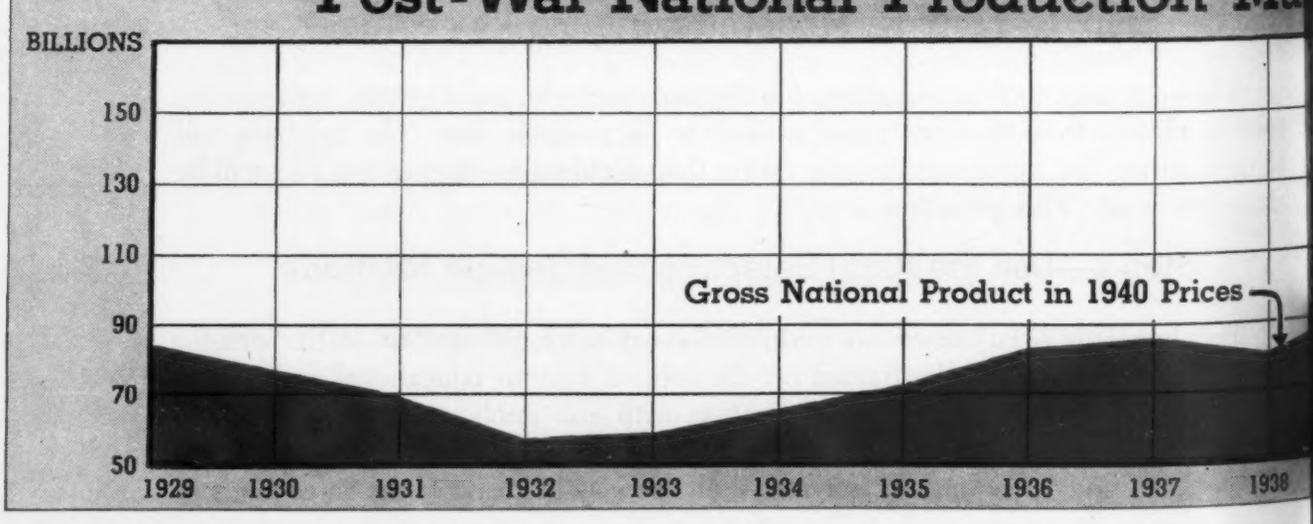
Some companies have long known that the management personnel does not include all the people with ideas. Management and labor, expressing ideas and working them out together, will achieve more output of product for a given input of human energy, materials, and power than either management or workers working alone. Wartime experiences, in this country and in Great Britain as well, have strengthened the conviction that production can be increased by such joint action. Among the means are suggestion systems, rewards (both monetary and honorary), stimulation of morale, educational programs. Hence,

## Step 5—Benefit From Labor-Management Cooperation

Having procured, selected, and trained workers; having provided incentives to stimulate their production; and having established the paths by which advantage can be taken of the thinking ability as well as the plain working ability of wage earners, it is necessary to keep workers on the job and to keep them fit to work. Medical departments will help. So will recreational programs. So will education in matters of nutrition. And, of course, the safety program. They constitute

## Step 6—Carry On Health and Safety Activities

Thus there are six major steps to be taken by plant operating executives if they are to use their manpower most effectively. In six words they are Get, Select, Train,



Reward, Encourage, Protect. In addition, there is the inseparable influence upon the most effective use of manpower of the steps that are taken

## To Insure the Best Use of Equipment

There are four such steps. First, what general method of manufacture shall be used? Shall it be straight line, functional, or a combination of the two? The answers lie in the kind of product and the amount of it to be made. So,

### Step 1—Select Layout and Handling That Suit Your Product

With the general method established, the next step calls for refinement—and refinement that never ends. By time study, by motion study, by methods study, layout is improved and the use of both manpower and equipment becomes more and more effective, not by abrupt and arbitrary change, but by the orderly process of evolution. This step is closely related to the steps that have to do with training, incentives, and cooperation. It is

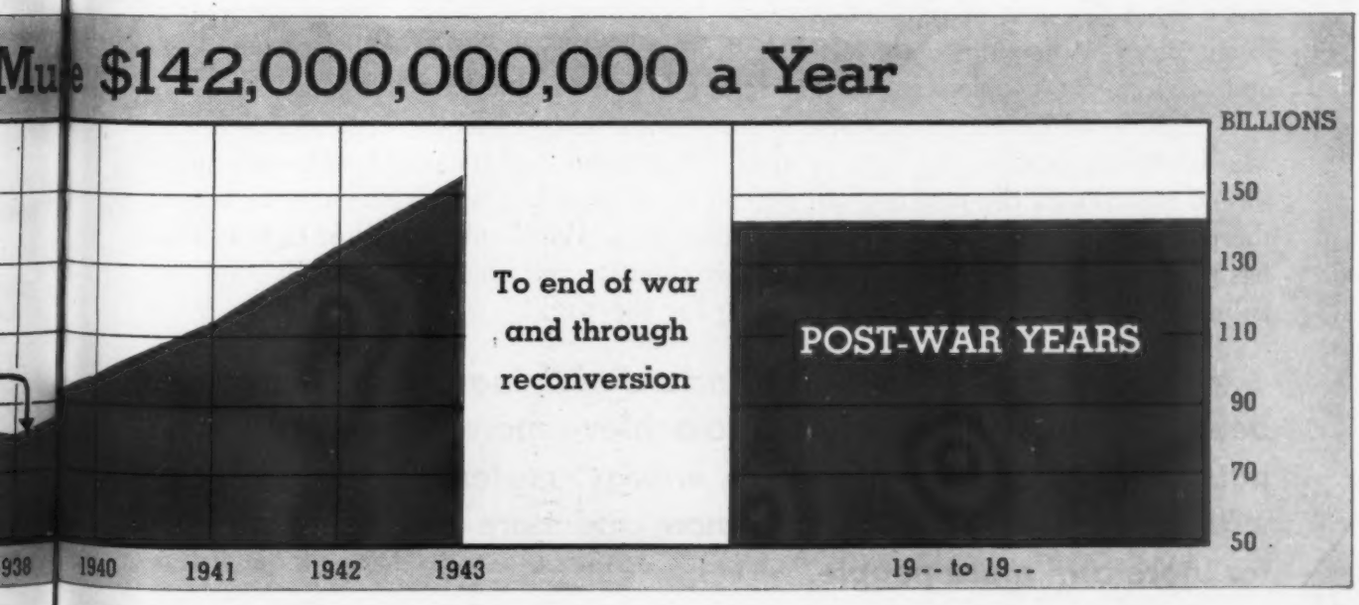
### Step 2—Find the One Best Way of Manufacture

A necessary adjunct to the one best way of manufacture is some means of seeing that it always delivers the right amount of product at the right cost at the right time. The broad general terms for this means is "paperwork." Behind the correct paperwork must be the right amount of know-how plus the proper equipment, consisting of such tools as schedule boards, scheduling and routing systems, record making and keeping devices. Interpreting this step in a declarative statement, we say to take

### Step 3—Use Effective Production Control

And, finally, the machines and other equipment on which the production is done, and the buildings in which it is done—including the services such as power and light

"In 1940 prices, the gross national product would be around 142 billion dollars," says the Bureau of Foreign and Domestic Commerce, in figuring the potential capacity of the manpower available for gainful employment (55,500,000) in 1946. Gross national product is defined as the total cost of goods and services to the ultimate consumer, including producers' capital goods and government services. Comparable figure for 1939 is $89,000,000,000



—must be kept in such condition and readiness that the manufacturing activities can go on. Involved are activities like planned inspection of equipment, scientific selection and scheduled application of lubricants, the provision and upkeep of adequate electrical and mechanical services. To carry out this procedure is by no means easy, but to do so is vital. It is imperative to take

## Step 4—Maintain Machines and Services for Continuous Operation

It is with the ten steps enumerated that this third annual National Production Issue of *Factory* deals. In each of the ten sections that follow, one of the steps is taken up. The fundamental principles involved in the step are set forth and a generous number of cases are presented to demonstrate the application of those principles and to support our contentions relative to their essentiality. *Each of the ten steps is essential in wartime; each will be essential in the post-war period.*

Industry in this country has now, as it has never had before, an opportunity to prepare for the future while it does not have to worry about the present. There are immediate troubles, to be sure, but on the whole industry has its orders determined by the requirements of the war, so that it can devote its undivided energy to using its manpower and its equipment most effectively, and learning from its experiences of today the lessons that it will put into practice later on in its peacetime production.

How big will industry's post-war production job be? Reliable people, in industry and elsewhere, who have given this question much thought, say that some 56,000,000 people will want gainful employment; and that their requirements each year in terms of goods and services to be turned out by industry will be $142,000,000,000 at prices of 1940, the last prewar year. In order to know how big a job those two figures represent, consider the actual figures for 1940. The gainfully employed that year totaled 46,000,000 and industry produced $100,000,000,000 worth of goods and services.

The thought could be advanced that our employment today is much bigger, as is our production—in spite of high costs and high selling prices for industry's goods. When this argument is advanced, reasoning has not been carried far enough. People will pay almost any price in time of national emergency, when they foot the bills in the form of government spending. But as individuals they buy freely only when prices are attractively low.

The spark plug of the large-consumption economic engine is low cost of production. From low cost of production stems low selling price, which brings about great distribution. When this cycle has been followed in connection with enough goods and services, the people have a high standard of living, and there are jobs for all.

The conclusion seems inescapable that during this period of intense production for war we should be planning how to make for post-war; and that our how-to-make plans should incorporate the results of all we can learn from our war experiences in making the most effective use of manpower and machines. We should never lose sight of what has made the high standard of living in this country, and which presumably can contribute greatly to a high standard of living for the world.

***What has made the high standard of living in this country has been industry's ability always to achieve more output of its products with less input of human energy, materials, and power—with consequent production of more and more goods and services for more and more people.***

# How to Make the Most Effective Use of MANPOWER

# HOW TO MAKE THE MOST EFFECTIV

# STEP 1 Employ Modern

IT WOULD BE IDLE to belabor the point that industry must dig still deeper into the nation's labor reserves as the war goes on.

There are no more unemployed. Within the year the armed services will claim at least 2,000,000 more men. The munitions industries alone must recruit at least 1,600,000 more.

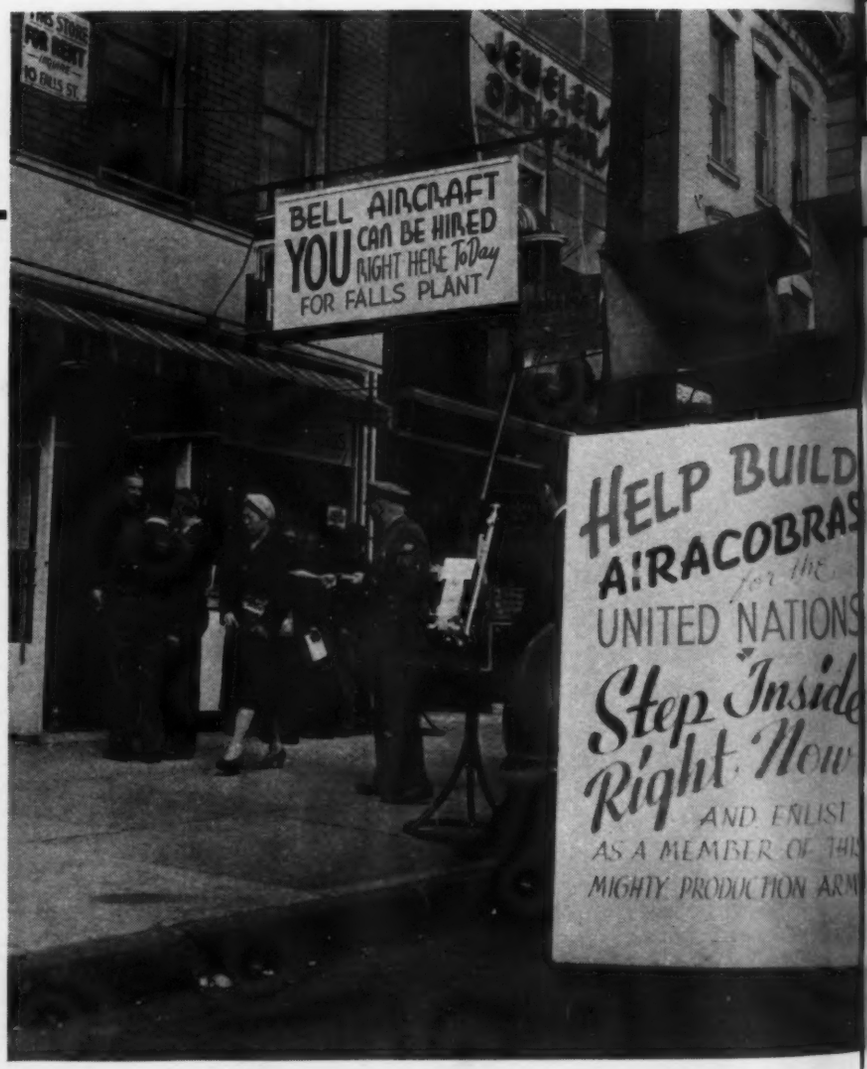
The emphasis in hiring has changed completely. Witness the case of a West Coast aircraft company which, from 1939 to 1941, built a picked force of 60,000 men chosen by scores of interviewers in dozens of cities.

"Most of these men have melted away," the company reports. "All must be replaced, faster than they disappear and with a discouraging turnover of about 60 percent annually."

This company now talks of "adapting its factories" to workers who, a year ago, "would have been deemed completely unsuitable."

Management's course is clear. Four steps are required: It must:

1. Get the applicant's attention.
2. Recruit and induct women.
3. Utilize handicapped workers.
4. Tap "white-collar" reserves and recruit retired oldsters.




**Loudspeakers attract prospects to Bell Aircraft's downtown recruiting center. Applicants are interviewed and hired on the spot; station wagons whisk new people to the plant for further "processing"**

# Recruiting Procedures

The cases presented here were chosen with a special eye to their general applicability, their novelty, or both, and are grouped according to the four steps noted above.

* * *

Management's ingenuity has been put to severe tests in many areas where the sheer task of getting the attention of prospective applicants has been a primary problem.

Both ingenious and effective have been the methods developed to meet this problem. In some cases, individual managements worked out plans of their own. Occasionally the cooperative principle has been applied by war industries of entire communities.

## Ads That Do a Selling Job—*Union Nation Radio*

Original and appealing classified newspaper ads, display ads, and car cards have brought an ample number of applicants to the doors of National Union Radio Corporation, Newark.

"Straight, bulletin-type ads, no different from those of other local war plants, proved pretty ineffectual," confesses a National Union official. "Then we analyzed the situation. Actually what we had to do was a selling job. The old, familiar rules of salesmanship, we thought, could be applied—including emotional appeal."

Verse, love letters from a soldier to his sweetheart, and the story of "Foxhole Joe" (whose life was saved by radio equipment) began to brighten the drab classified columns of the Newark and New York papers.

"Unconventional? Certainly," the company admits. "Sentimental, too—in the eyes of our amused competitors—but it did, and still does, pull. Response was two to three times the normal number of applicants."

A good sample is the ditty headed "These Girls Joined—Why Not You?" In it we learn that "Mary was a manicurist, Sally waited table, Joan pranced around a store, showing mink and sable." Then they met Maureen, "asked where she was working. Proudly Maureen told them, war work was her job, the battle of production, backing flier, soldier, gob."

At the end, of course, they all "join the thousands of girls, 16 to 45, who are doing their bit at National Union—making the radio tubes so desperately needed by our fighting men."

Geared to induct large numbers of women readily, National Union has slanted its copy in their direction, particularly to those in non-essential occupations.

## Downtown Employment Office—*Bell Aircraft*

Combining every sort of newspaper and radio appeal with the "bring a friend" principle, Bell Aircraft Corporation, Buffalo, has launched an all-out effort to recruit new personnel in an "acute manpower shortage" area.

In downtown centers of Buffalo and other Niagara frontier cities, Bell set up auxiliary employment centers wherein the passing public may stop and watch actual Bell employees at work on machines transplanted from the plant. Loudspeakers and music draw the throngs. Within, interviews are conducted and people are hired on the spot. Station wagons stand ready to whisk new "hires" to the plant for further "processing."

Bell employees periodically receive application blanks for distribution to

friends. Boxes are set up in the plants to receive returns. Radio appeals for Bell recruits, specially prepared on disks by such popular figures as Lowell Thomas, Major George Fielding Eliot, Ted Husing, Frank Sinatra, and Madeleine Carroll, are broadcast as spot announcements over local stations.

## "Bring a Friend" Drive—*Carnegie-Illinois*

To tap the reserve sources outside the normal manpower market, Carnegie-Illinois Steel Corporation, Pittsburgh, hit upon its successful "Bring a Friend" drive in which it enlisted the company's own employees as "talent scouts." Carnegie's idea was to "make" new personnel, recruited from every conceivable former occupation, rather than attempt to "find" replacements. This created an unprecedented placement problem. A battery of tests, sampling the applicants' clerical and mechanical potentialities, was devised to guide them into appropriate types of work.

The company also devised a series of induction films to take the mystery out of industrial work and prepare the new employee to take full advantage of the training program. Work relationships, working conditions, safety and health rules, and the employee's responsibilities and privileges are explained in these films, keeping initial maladjustments to a minimum.

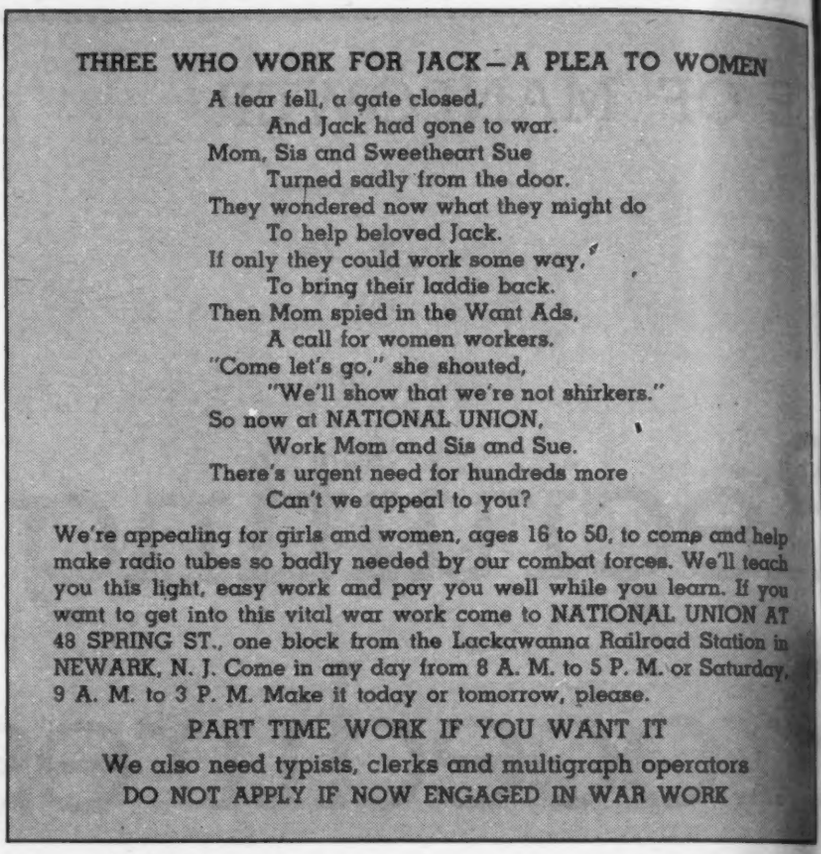
## City-Wide Canvass for Women—*New Britain*

In 40 days the busy little city of New Britain, Conn., dug up 2341 housewives for industrial war work in a cooperative campaign staged by eleven principal companies which organized a War Manpower Committee with the aid of the Chamber of Commerce, the U. S. Employment Service, the City Defense Council.

All the arts of publicity were employed to lay down a heavy pre-campaign barrage, including newspaper ads, billboards, posters, movie trailers, and "talking" shop windows where women worked at machines transplanted from factories.

Then, in a carefully "pre-sold" market, the real house-to-house drive began. Women workers from the plants themselves were chosen as canvassers and paid regular weekly earnings while on the job. Thus every canvasser was ready with an answer when anyone asked, "What are you doing to help win the war?"

Going still further, New Britain set up child-care centers and machinery to cope with problems of housing and transportation, and even to deal with questions relating to the Selective Service status of male members of the families of prospective job-applicants. (For details of this outstanding experiment, see "How New Britain War Plants Recruited Women Workers," FACTORY, April, 1943.)



THREE WHO WORK FOR JACK—A PLEA TO WOMEN

A tear fell, a gate closed,
And Jack had gone to war.
Mom, Sis and Sweetheart Sue
Turned sadly from the door.
They wondered now what they might do
To help beloved Jack.
If only they could work some way,
To bring their laddie back.
Then Mom spied in the Want Ads,
A call for women workers.
"Come let's go," she shouted,
"We'll show that we're not shirkers."
So now at NATIONAL UNION,
Work Mom and Sis and Sue.
There's urgent need for hundreds more
Can't we appeal to you?

We're appealing for girls and women, ages 16 to 50, to come and help make radio tubes so badly needed by our combat forces. We'll teach you this light, easy work and pay you well while you learn. If you want to get into this vital war work come to NATIONAL UNION AT 48 SPRING ST., one block from the Lackawanna Railroad Station in NEWARK, N. J. Come in any day from 8 A. M. to 5 P. M. or Saturday, 9 A. M. to 3 P. M. Make it today or tomorrow, please.

PART TIME WORK IF YOU WANT IT

We also need typists, clerks and multigraph operators

DO NOT APPLY IF NOW ENGAGED IN WAR WORK

**When straight advertising proved ineffectual, National Union Radio used love letters from soldiers and ditties like the above. Result has been a steady stream of applicants. Case study on page 89**

## Dramatization of Factory Jobs—*American Optical*

In downtown Southbridge, Mass., the American Optical Company opened a temporary employment center to dramatize industrial training and work. Showcases displayed optical products made for the Army and Navy as well as safety goggles in use. Girl demonstrators worked on transplanted lens machines. Amid comfortable surroundings, applicants were interviewed by company personnel people.

A useful byproduct of the plan was its excellent public relations effect. At least 6500 persons, including many AO employees and their families, learned more about the company by visiting the display.

## Employment of Workers' Relatives—*Toledo Scale*

Relatives have their good points, in the experience of Toledo Scale Company, Toledo, where more than 20 percent of the employees are related to someone else in the organization. As one man said:

"We don't have absenteeism. How can I stay away for a day, much as I might like to? Aunt Minnie drives up to the door every morning and yells at me to come out and go to work."

Relationships show 28 sons, 16 brothers, 12 wives, 8 daughters, and 8 sons-in-law, 1 grandson. No daughters-in-law, which doubtless has some cosmic significance. The rest scatter through sisters, cousins, uncles, and whatever.

* * *

Management's second step is to recruit and induct women. By the end of this year they will constitute nearly one-third of war industry's working force. That's another way of saying that management has already done a brilliant job of hiring and training

workers drawn from this unaccustomed, but primarily important, source of manpower.

In December, 1941, there were only 1,400,000 women war workers; a year later there were 4,000,000; by December, 1943, there will be 6,000,000. Nor is that the end. Millions more may yet be needed. Industry will have to draw heavily, then, on the lessons it has already learned in the techniques of recruitment and induction. Most of the single women have been hired. There remain less than 4,000,000 non-farm housewives under 45 without children requiring care—and many of these live in inaccessible areas. The emphasis will thus shift to women with children and women over 45.

Here follow some useful cases in the selection and utilization of women in industry.

## Induction of All-Woman Force—*Northern Aircraft*

The first aircraft engine and propeller parts plant in America to employ women exclusively (with the exception of job-setters, supervisors, and instructors) is the Northern Aircraft Products Division of the Aviation Corporation at Toledo.

The all-women working force was planned from the start. W. R. Hamilton, plant manager, and John MacLachlan, superintendent, intend to retain the policy as the plant swings into full operation. Well pleased with results to date, Executive Vice-President William F. Wise of the Aviation Corporation says this:

Only about 20 percent of the women have had previous factory experience. The judgment of the personnel office, as to an applicant's personality, alertness, and adaptability, has weighed primarily in selection. Physical examinations are given and care is taken to make sure that an applicant's work won't leave a gap in her home if she has dependents.

At first drawn from vocational schools, applicants now go directly to in-plant training. Six weeks usually suffice to prepare a competent machine operator.

Men's wage rates are paid for a standard 7½-hour day. No overtime is allowed. Supervisors, in giving instructions, are required to consider carefully the fact that women constitutionally are better equipped for sidewise arm motions than for lifting movements.

At the start, employees are warned

**Women make up about 75 percent of the workers on the final inspection line at Bendix Aviation's new Illinois Division. Simplification of operations and an effective training program made it possible**

against carrying social ties and "temperament" into the shop. They are urged to confide personal problems to the personnel office, which rigidly guards secrets.

Each employee goes to a Toledo department store to choose a becoming outfit from the stock of the company's uniforms on hand there.

## Selection of Suitable Women—*Perfect Circle*

An advocate of planning and preparation for the induction of women workers is Howard M. Dirks, industrial relations manager of Perfect Circle Company, Hagerstown, Ind.

This, he believes, carries beyond job analysis, the provision of proper safety clothing, sanitary facilities, restrooms, and the like—to all of which Perfect Circle has paid more than ordinary attention. Dirks thinks also that the male supervisory and line personnel should be prepared psychologically for the change so that they can, in turn, "sell" the idea to subordinates who might otherwise resent it.

"No supervisor is going to manage women successfully if he is antagonistic to their employment," he points out. He urges that supervisors be asked to participate in planning for the induction of women at the outset on the ground that, if they know all the facts, and help in the preliminary stages, the program will be theirs as well as top management's and they will go along with it completely.

This factor and the careful selection of the most suitable women applicants are emphasized because of the belief that "the attitudes of women are conditioned more by their associates than by the nature of the work they do."

Like other companies, Perfect Circle tries to avoid employment of women whose jobs conflict with home responsibilities; nevertheless, like other companies, it finds turnover among women higher than among men.

## Employment of Women—*Westinghouse*

Women employed in shops and offices of Westinghouse Electric & Manufacturing Company made up 26 percent of the payroll at the end of 1942, representing an increase of 55 percent over the previous year.

They are placed on jobs established as suitable for women, and are paid in accordance with the stipulations of the women's key sheet, which is part of the union contract. The key sheet establishes differentials between the pay of men and that of women employees. When a pay rise of 5½ cents per hour recently was given to men, women shop workers at the same time received an increase of 7½ cents per hour. Women on men's jobs receive the men's rate.

**One successful recruiting technique consists simply of asking workers to "bring a friend." This mother went one better and brought her daughter. They run adjacent machines in a Westinghouse plant**

Taking into consideration training time and practical experience, the opportunities for advancement for women are comparable to those for men, except that advancement to supervisory positions is more limited. Experience has shown that men make better supervisors for female workers than do women.

Seldom is the method of doing a job the same for both men and women workers. At Westinghouse, for example, all industrial relations managers have been instructed that descriptions of a job must be rewritten when the job is assigned to a woman. This is because various services must be provided for a woman to eliminate heavy work.

Jobs are arranged in 10 labor grades, depending upon the skill required. Rarely does a woman rise above grade five. Supervisory posts might be graded at a theoretical 15.

* * *

An important war lesson, which many employers have learned, is that the employment of handicapped people is not a question of making the best of a necessity, but one of seizing a real opportunity to add productive, capable, cheerful employees to the working force. Withal, the news spreads slowly. As a result, a potential manpower source, estimated at 700,000, is by no means exhausted.

## Enlisting Handicapped Workers—*Lycoming*

A challenging thought is expressed by P. E. Garlent, vice-president of the Aviation Corporation's Lycoming Division, Williamsport, Pa., where today 250 persons turn in a good day's work despite partial physical disabilities. Lycoming, says Garlent, experienced a "complete awakening" after it agreed, somewhat reluctantly, to take on a few workers proffered by the Rehabilitation Service of the Pennsylvania Department of Labor and Industry, via the Williamsport Technical Institute.

"We learned that these people were not really 'handicapped' at all,"

**There are 250 handicapped people at Aviation Corporation's Lycoming Division, but the management does not call them that, for reasons explained in a case study which begins on the facing page. They work to close limits and their production records stack right up against all others in the plant**

Garlent declares. "A one-armed man may be handicapped with respect to running a typewriter, but not with respect to certain clerical jobs. A one-legged man may be handicapped with respect to driving a truck, but not with respect to running a typewriter. We soon found that a deaf man, who was handicapped with respect to a job in which conversation was essential, was certainly not handicapped on a job on which he could get specific written instructions."

Lycoming emphasizes "self respect, not charity."

"Rehabilitation takes effect when a man who thought he was handicapped suddenly finds he can turn out not only just as much per hour as the next fellow but a little bit more—and a little bit better," Garlent explains. He warns, however, that induction of the handicapped is not simple, that a primary problem is to get the worker out of the frame of mind his condition has induced.

"The chances are, human nature being what it is, that the worker himself has been convinced he is 'handicapped,'" Garlent says. "So, when he comes to work, he has the feeling he is not able to do what other people can do. Furthermore, he may have been given the idea that he is entitled to special consideration.

"As long as he feels that way, he isn't worth a nickel to himself or anybody else. But once he becomes a normal workman competing with other workmen, he picks up his head and begins to go to town."

And "go to town" they do, at Lycoming—at vital jobs like making piston pins, push rod sockets, link pins, rocker roller pins, rocker rollers, and valve follower guide pins for aircraft engines. They operate internal, external, and centerless grinders, milling machines, and thread grinders, and work ably to close tolerances. Also—

"They are enlisted in the army of production for the duration," says Garlent, "whereas many of the men who go into a plant today have one eye on the machine and the other on the Army."

Post-war-wise, Garlent points out, the employment and training of handicapped men today will prepare industry for the job of re-absorbing injured war veterans later on.

## Recruitment of Blind Workers—*Asheville Mica*

To sort and classify rough pieces of mica in thicknesses as fine as three-fourths of one thousandth of an inch, a worker having normal vision must use a micrometer. The blind, however, can do the work as well or better by touch alone.

In fact, Chester Charp, one of 19 blind workers at Asheville Mica Company, Asheville, N. C., holds all plant production records at the job. Nor are his 18 colleagues far behind him.

The idea was James Penland's. He is placement agent for the North Carolina Commission for the Blind. Penland's wife, who has only 5 percent vision herself, made the first study of the job's techniques and originated the six-week training course which equips others for the work. She supervises the department which, for lack of space, is established at the Asheville Lions Club workshop.

## Employing Handicapped People—*Kreisler*

James Cassidy, who has a "bum wing" himself, went to work as a timekeeper for Jacques Kreisler Manufacturing Corporation, North Bergen, N. J., about two years ago. Personnel problems were soon to become acute for this jewelry manufacturer already turning to a full schedule of war work. Today Cassidy is personnel manager with *carte blanche* to push still further his successful experiments in the utilization of handicapped workers on every sort of operation, including assembly, power press, lathe work, and polishing.

Now 50 in all, they comprise the entire second shift in one department and are active elsewhere in the plant.

"We have noticed that production in the various departments where the handicapped are employed, has gone up considerably," Cassidy reports. "Not only that, but they put to shame

other employees who are not handicapped. Production has gone up noticeably throughout the plant."

When the call came for blood donors, Kreisler's handicapped workers volunteered 100 percent.

## Employment of Blind—*Walter Kidde*

When Arthur Voorhees, supervisor for the New Jersey State Commission for the Blind, approached Walter Kidde & Company, Bloomfield, N. J., he advanced as one argument for the employment of blind persons the fact that, according to the Commission's 42-year records, no blind person in New Jersey has been involved in an industrial accident.

This has been borne out to date by Kidde's experience in the use of blind workers. B. F. Corcoran, director of training, was aided in their induction by Voorhees who, blind himself, is an expert turret lathe operator. Blind employees now work with regular employees at inspection jobs, retapping of faulty valve threads, and several types of assembly.

Work spoilage among the blind is low, likewise absenteeism, Corcoran reports. Fellow-employees, admiring their desire to produce, have helped by devising special jigs to facilitate their work. In fact, the plant personnel do all in their power to make the blind feel at home, which has had an excellent effect on their morale, their attention to personal appearance, and general outlook.

"The experiment of employing these people has proved so successful all around," says the Kidde Company, "that more of them are being taken on whenever they apply, not out of sympathy and not because the company is being forced into it, but because it has been demonstrated that, when the individual is suited to the job, a blind worker can stand up to any competition and show his heels to normal workers on several scores."

* * *

A source of reserve manpower whose extent is impossible to estimate, lies in the part-time "white collar" group.

An early and important step was the "split shift" initiated in April, 1942, in Hartford, Conn., a logical site since this industrial city includes a perhaps exceptionally high proportion of white collar workers in insurance companies and banks.

The "Hartford Plan" began, in fact, around a luncheon table where a handful of businessmen decided to find an outlet for the urge to join the battle of production. With the aid of the Connecticut office of the United States Employment Service, a white collar manpower pool was set up with two experimental teams of three men each to work a 5-hour shift, from 6 to 11 p. m. twice a week for a six-day week.

This was a schedule on which an employer could plan. First to take it up was Hartford Steel Ball Company, then Pratt & Whitney. With variations, the principle of utilizing white collar men has become widespread.

## Victory Split Shift—*Bell Aircraft*

More than 1000 new employees have been brought into production in Bell Aircraft Corporation's (Buffalo) "victory shift," under which two persons fill a single full-time job, each working 8 hours on alternate days.

This opens the payroll not only to merchants and professional men who wish to keep their hand in at their peacetime occupations, but also to women with home responsibilities. Three days of work, for which child care can more easily be arranged, are balanced by four full days at home. One mother-daughter team shares a Bell job and the task of caring for the younger woman's baby.

## Victory Part-Time Shift—*Macallen*

Little suspecting the depth of the potential white collar reserve, the Macallen Company, South Boston, Mass., ran a small display ad in a Boston paper announcing the opening of a 6 to 11 p. m. "victory shift" for business and professional men.

More than 2000 applicants formed a line blocks long that waited in the cold to be interviewed on the first day. Most of the applicants proved to be promising types. As a matter of fact only two out of several hundred initially interviewed were found to be wholly unsuitable.

Analysis shows that the patriotic motive is blended with necessity. The white collar worker is frequently the "forgotten man" of the war effort who must augment his fixed income to meet higher living costs and the increase in taxation.

Turnover is admittedly high. Some "nine-to-fivers" found they lacked physical stamina. Many wives liked the extra income, but objected to being left alone five nights a week. The 35 percent who did stay on, however, were found to be exceptionally apt, productive, and reliable.

Statistics of the Macallen shift reveal that 19 percent are college graduates. The 24 universities represented include not only Yale, Harvard, and

**The circular workplace has been a big help in training blind people on light assembly work at Walter Kidde & Company. This girl is assembling a valve and using a jig designed by another worker**

**Fifty-seven men came to Divine Brothers in response to a plea in the classified columns for production "Minute Men." They pitched in on a rush job and helped a lot. Some signed on for permanent jobs**

**Don't overlook the older men, says Curtiss-Wright, which has hired many of them**

other American schools, but also Oxford, Paris, and Glasgow.

Regular daytime employment of the workers includes: Executives, 10; teachers, 21; trades, 93; laborers, 29; insurance, 34; band and financial, 25; general clerical, 90; sales, 84; professional, 26; self-employed, 16; service, 70; accountants, 33; milkmen, 6; postal employees, 12; shipping and receiving, 19; stockkeepers, 15; factory workers, 42; utilities workers, 33; civil servants, 90; traffic and freight, 4; private service, 5; protection and police, 11; student, 1; retired and unemployed, 2; research, 8; inspectors, 20; technical, 2; and buyers, 5. The average age of all applicants was found to be 40.5 years.

## White Collar Evening Shift—*Jenkins Brothers*

Several months ago an unexpected manpower shortage in the shipping department of Jenkins Brothers, Bridgeport, caused a bottleneck which the company decided to break by advertising for temporary white collar helpers. So pleased was Bernard J. Lee, vice-president, that he instituted a 6 to 11 p.m. shift on productive work which was quickly filled by apt and willing bank clerks, salesmen, bookkeepers, lawyers, and brokers.

"Most of these men have brothers or sons in the armed forces, and realize the importance of our valves in the shipbuilding program," says Lee. "They are quick to learn their jobs, take exceptional pride in their work, and are eager to get first-hand knowledge of plant conditions, which is sometimes valuable to them in their daytime work."

Jenkins Brothers also runs separate ads for part-time tool designers and toolmakers to which the response has been good. The appeal to women workers has not been neglected either. In a full-page display ad, copy signed by the newspaper's society editor was used to good effect.

## Production "Minute Men"—*Divine Brothers*

Faced with a rush job demanding the immediate addition of considerable manpower, Divine Brothers, Utica, N. Y., set vigorously about the recruitment of a white collar part-time shift. A "Paul Revere" plea for production "Minute Men" was the theme of newspaper advertising.

The rush job involved the rebuilding of 70 special machines, overhauling motors, welding and steamfitting, machining and refitting parts, adding new parts, testing, and unpacking and packing in 2-ton crates. Thanks to careful supervisory planning, the 57 novitiates were a lot more help than hindrance as they pitched into the simple bolt-removing, screw-loosening, and carrying tasks to which they were assigned.

"They learned fast and did well," reported Frank Gorton, shop superintendent. "The beauty of the whole achievement was that our regular production rolled along uninterruptedly."

Seven of the 57 signed on immediately for permanent jobs.

## Recruiting Older Men—*Curtiss-Wright*

Not to be overlooked, in today's acute manpower shortage, are the oldsters who have been pensioned off, or who have retired. And they are not overlooked in the New York State plants of Curtiss-Wright Corporation's Airplane Division, where many older men are being hired.

In an all-out war, no man is too old. For instance, Arthur Lane. A mere 68, he worked 33 years for American Railway Express, was pensioned off back in 1939. His son died in the dusty street of a Spanish town.

"These are no days," said Lane, "for a man to be living idly on a pension." Today he works on the burr-rack bench in the press and cutting department—just one of the long list of oldsters who have joined the production ranks at Curtiss-Wright.

Although most of these Curtiss-Wright oldsters are trained men, there are a number who never worked in a plant before—retired school teachers, businessmen, even some professional men. They all make good, reliable workers, liked by other employees, and praised by their foremen.

Work in the airplane industry is, for the most part, light. Older men without skill can be placed on jobs that require no heavy physical work. Men with trades, despite the fact that they may not have worked for years, quickly master the improvements that have been incorporated into machines and once again become experts.

# HOW TO MAKE THE MOST EFFECTIVE USE

# STEP 2 Use the R Selection M

**Aptitude tests are being used with great success by Sperry Gyroscope Company in selection and placement of inexperienced women on work done in the past by skilled men.** **Case study on page 101**

SELECTION AND ASSIGNMENT of new employees, together with reassignment and upgrading of those already employed, represent the four personnel functions that govern the extent to which manpower is efficiently utilized in any war industry. Expanding production at a time when the supply of qualified workers is steadily dwindling makes it imperative that maximum use be made of every man and woman from management right down the line. Aptitude testing is making an important contribution toward this goal of industry's.

During the past year the argument has been raised that testing is useful only when a plentiful labor market permits skimming off the cream of the best workers, and that in times like these the employment office cannot afford to eliminate applicants on the basis of test scores. It is true, of course, that present circumstances make it necessary to hire many people who formerly would not have been considered. Actually, however, a considerable amount of "weeding out" still takes place, and the experience of many companies shows that testing helps to speed up this process

USE OF MANPOWER

# Right and Testing Methods

and make it less likely that any good material will be overlooked.

Although initial selection still is an important function, the most critical step in the whole employment procedure is the *assignment of the new worker to the job for which he is best qualified.* It is one thing to decide the applicant is a "good man," but far more difficult to judge just where he will be most useful. Tests bring to this problem such valuable information as: (1) How fast this man can be expected to learn; (2) how much "mechanical savvy" he has; (3) how fast he can work with his hands; and (4) whether he has the specialized physical and mental skills which the job specification lists as essential for the various jobs within the plant. Such information provides the placement interviewer with a better basis for deciding whether the new worker can make his best contribution on some rather low-grade, repetitive job or has the capacity to be trained for a more complex assignment.

Although this decision is hard enough to make in the case of men, it is even more difficult where women are involved. The almost complete absence of any comparable work history makes assignment of women to jobs practically a matter of pure guesswork, unless some objective measure of their abilities is at hand.

In any comprehensive manpower-utilization program, the possibility of reassignment of employees already on the job should not be overlooked. One company, faced with converting plant facilities from manufacture of a peacetime product to production of Army and Navy ordnance matériel, tested the entire plant personnel.

## New Talents Uncovered

As might be expected, results showed that a number of employees were working much below their possible capacity. Stockroom clerks were found to have the ability to learn the operation and set-up of machine tools. Men working on routine subassembly jobs were revealed as capable of mastering complex final assembly tasks. When reassignments were effected, these people, almost to a man, made good on their new jobs.

Promotion of workers to supervisory responsibility represents the final place where testing can be helpful. Just as the Army has found that a candidate for Officers Training School must make a score of at least 110 on the General Classification Test, industry is learning that men should not be entrusted with leadership on the job unless their mental ability is at least above average. This is not to say, of course, that intelligence is the only requirement. Appropriate personality qualifications and job knowledge should be given equal weight in any consideration of leadership promotion. In spite of some published material to the contrary, however, it is the general consensus that tests designed to measure personality characteristics of leadership have not yet progressed to the state where they may be considered a valid instrument for industrial use. The determination of these factors can best be made by evaluating the individual's work experience, training, and personal history through the use of a comprehensive interview technique.

A careful analysis of the results of aptitude testing in industry shows that the prediction of subsequent success on the job by means of tests is

not 100 percent perfect. Indeed, tests are likely to be of no value at all unless properly selected and installed by someone specially trained in their use and in their interpretation, and used together with personal data obtained by the interview.

Some companies have tried using various tests on their own, with the hope that long-term results would reveal their value. Attempts have been made also to use tests by mail and interpret results without benefit of personal interviews with applicants. Such haphazard programs have not generally borne fruit. For this reason several of the major test distributors no longer supply test materials to companies where the testing and interviewing program is not under the direction of a professionally qualified person. Extensive, long-range research, however valuable, is beyond the scope of plants that want to make immediate use of test results. Their best course of action is to call in a consulting specialist who can: (1) Make the best selection of tests based on his experience in comparable industrial situations; (2) train someone in the personnel department to administer the tests and interpret the results; and (3) conduct a follow-up program to evaluate the results obtained, in order that any necessary revision in the original test battery may be made.

## Batting Average Lifted

Where these procedures are followed, the tests can usually be relied upon to improve the personnel department's "batting average" in selection, assignment to jobs, reassignment, and upgrading. The names of test consultants can be found by referring to the membership list of the Industrial Section of the American Association of Applied Psychology.

Although many kinds of tests have been developed for use in schools and psychological clinics, industry has found only a few of practical value. These are (1) general intelligence tests, (2) mechanical tests, and (3) clerical tests. As indicated below, there are several types of mechanical and clerical tests. In general, no one test alone can do the selection job. Even the relatively simple factory and office jobs require several abilities or skills, and a different test must ordinarily be used to determine each. Thus a group or battery of tests has been most frequently used where successful results have been obtained.

The decision as to what tests should be used is based upon a careful analysis of the kinds of abilities needed on each job. This is one of the critical points in the installation of the testing program, and requires the services of a person who has had wide experience in adapting and developing tests for industrial use. Fortunately, there are usually enough common elements in most plant and office jobs so that a few tests will suffice. It is the interpretation of the scores on these tests that governs the decision as to which job the applicant is assigned. Thus a composite score showing good intelligence and mechanical understanding, but only average finger and hand dexterity, might indicate that the person should be assigned to training as a machine operator, while another score revealing below average intelligence and mechanical understanding, but good finger and hand dexterity, would mean that he should be given a routine assembly job where production was almost entirely dependent upon speed of manual movements.

But if tests are to be used at all, the test administrator must be carefully trained. Some companies have entrusted this responsibility to low-paid clerks who have had no training in testing. This person is provided with a test manual of directions and told to "go right ahead because there is nothing complicated about giving tests."

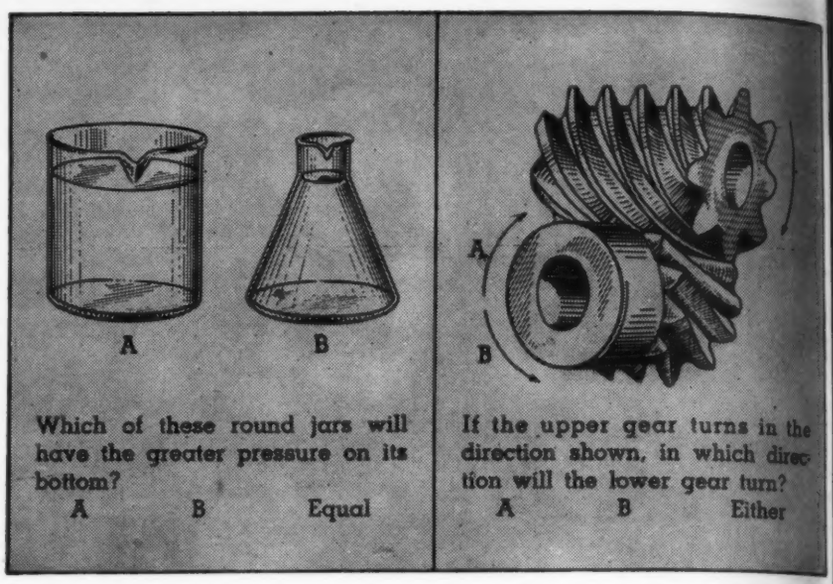

A
B
Which of these round jars will have the greater pressure on its bottom?
A B Equal
A
B
If the upper gear turns in the direction shown, in which direction will the lower gear turn?
A B Either

**Figure 1. Samples from Bennett Test of Mechanical Comprehension, which is used effectively, in conjunction with mechanical aptitude tests, to select men for training as machine operators**

1. How do you polish turned work in a lathe?
   *File* *Emery cloth* *Blunt tool* *Buffer*
2. For what is a dog used?
   *Turn work on centers* *Hold gear on shaft*
   *Hold tap for threading* *Make rough cut*
3. What happens if you file work that is turning too slowly?
   *File will chatter* *File will slip*
   *Work shows flat spots* *Remove too much metal*
4. Where is the live center located on a lathe?
   *In the tail stock* *On the carriage*
   *In the head stock* *In cone pulley*
5. What attachment is used to hold long work against the tool?
   *Check* *Johannson block* *Dog* *Follower rest*
6. For what reason do you say "dead" tail center?
   *Does not revolve* *Does not hold tool*
   *Acts as a guide* *May be used only in thread cutting*

**Figure 2. Items from a typical trade test which is designed to show just how much the applicant knows about running a lathe. This is called a multiple-type test, can be taken in about ten minutes**

**Figure 3. Clocking prospective riveter on a manual dexterity test at Republic Aviation**

**Figure 4. Republic Aviation uses this test as an aid to selecting women for subassembly work**

Needless to say, test results obtained in such a manner are rarely a valid measure of the applicant's abilities. There are innumerable little things that the untrained person either omits or does poorly.

Some of the more important points to be observed are:

1. Placing the testee at ease so that he will do his best.

2. Making sure he thoroughly understands the instructions before being allowed to proceed to the test.

3. Clear enunciation of directions.

4. Proper voice inflection where important passages need emphasis.

5. Strict observance of time limits indicated for each sub-test.

6. Proper control of the physical conditions of the testing room, such as light, heat, ventilation, and noise.

7. Great care in scoring the tests once they have been given.

## Intelligence Tests

Tests of mental ability are paper-and-pencil forms which can be administered simultaneously to a group of applicants or employees, and usually require from 20 to 30 minutes, depending on the test used. From 30 to 40 persons comprise a group that can be easily tested at one time by one administrator. This number can be increased considerably, however, where additional proctors, amplifying equipment, and sufficient space are available.

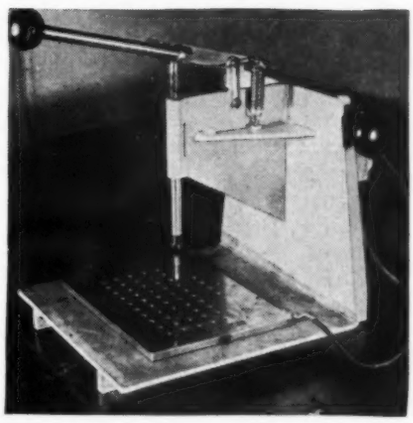


**Figure 5. Job sample test that is especially useful in picking people to run drill presses**

Some of the more frequently used intelligence tests in industry are: Otis Self-Administering Test of Mental Ability,[1] The Personnel Test,[2] various revised forms of the Army Alpha Examinations,[3] the Revised Beta Examinations,[3] and the Scoville Classifications Tests.[3] Each of these tests has its strong as well as its weak points, and only specialists in this field are capable of judging which test is best suited for a particular situation.

The intelligence test has two main purposes in an industrial test battery:

1. It will locate the applicants who can learn quickly and therefore have the capacity for eventual upgrading within the organization.

2. It indicates those with low scores who may be better for the less complicated assignments.

The latter value of intelligence tests is too frequently ignored. Actually, it is fully as important to find people with below-average mental ability for low-level jobs as it is to find those with higher intelligence for the more complicated positions. A large percentage of labor turnover on routine jobs is the direct result of placing men and women with too much intelligence on those jobs. These people find too little to challenge their imagination and ability, grow dissatisfied and bored with their tasks, and eventually quit.

The experience of most industrial organizations using tests has shown that the intelligence test should be included in the battery of tests given

[1]World Book Company
[2]E. F. Wonderlic and C. I. Hovland
[3]The Psychological Corporation

to clerical workers and in those administered to plant employees.

The Scovill Manufacturing Company[4] has had singularly significant experience in selecting apprentices for mechanical work by means of the Scoville Classification Intelligence Test combined with other mechanical tests. When apprentices were chosen by the interview alone, about 40 percent failed to make good on the job. When the tests were made a part of the selection procedure, those who could not make the grade dropped to 17 percent.

In connection with a program of test research at the Aetna Life Insurance Company, Dr. Martin Bills[5] followed the progress of 130 clerical employees over a period of seven years. These people were tested at the beginning of this period with a mental ability test known as Bureau Test VI.[6] At the end of the seven years it was found that of those who scored 80 or less on this test, 64 percent were still in the lowest-grade jobs, and only 12 percent had advanced to upper-level positions. But of those who scored above 100 on the test, only 15 percent were still working on low-grade jobs, while 55 percent had progressed to upper-level positions.

## Mechanical Tests

Mechanical tests may be roughly divided into three kinds:

1. Mechanical understanding
2. Job or trade knowledge
3. Manual dexterity and job sample

The Bennett Test of Mechanical Comprehension,[8] sample items of which appear in Figure 1, the Revised Minnesota Paper Form Board Test,[7] and the O'Rourke Mechanical Tests[8] are among the most used tests of mechanical understanding. Here again each of these tests has its own particular application, and expert opinion is needed as to which one would be most suitable for a given industrial situation.

The Bennett Test of Mechanical Comprehension, used in combination with a test of manual dexterity, proved most useful in selecting men for training as machine operators in one company. In this case, 91 percent of the workers rated "excellent" on the job, scored "A" or "B" on the tests; 75 percent of those rated "good" on the job, scored "A" or "B" on the tests; of all men hired since tests were installed, only 8 percent were rated "below average" on the job; not a single new man hired since tests were introduced as part of the selection procedure has had to be dismissed because of lack of ability to do the job.[9]

High scores on tests of mechanical understanding are most useful in selection of workers for such jobs as machine tool operation and set-up, complex final assembly operation, and sheet metal layout work. For many routine subassembly jobs, high scores on this type of test are not required because the jobs, although mechanical in nature, depend upon speed and coordination of the hands and fingers rather than upon ability to understand complicated mechanical principles.

Tests of job knowledge or trade information are used principally to determine whether the applicant possesses the degree of training and experience he claims on some particular skill. Figure 2 shows items from a typical trade test designed to indicate how much the applicant knows about the operation of a lathe. This is called a multiple-choice type of test and can be completed by the testee in about ten minutes. In times like these, when most people applying for jobs have had little or no previous mechanical experience, trade information tests are not widely used. In normal times, however, they provide a quick means of weeding out the "bluffers."

Manual dexterity and job sample tests, unlike the tests discussed above, are apparatus tests and must be administered individually. Although these tests involve more equipment and are more difficult to administer, they represent an essential part of the test battery for prediction of success on many jobs in the plant. Although a few dexterity tests, such as the Minnesota Rate of Manipulation Test and the O'Connor Finger and Tweezer Dexterity Tests, have had rather wide use, many of the most successful of these tests appear to be those which have been developed in the plant for a specific job situation. Figures 3 and 4 show manual dexterity tests in use at Republic Aviation Corporation, where they have been found to be of value in selecting women for riveting and subassembly operation.

Job sample tests are designed to provide a measure of the same kind of manual movements and coordination that are required on a specific job within the factory. Figure 5 shows a job sample test which has been found useful in selecting drill press operators. This particular test is equipped electrically to record the number of errors (touching the side of the hole with the drill) the applicant makes in completing the 50 holes in the plate. The first 5 holes are for practice. The total score is based on the time required to complete the 50 holes and the number of errors made. Some candidates finish this test in about 1½ minutes with only 2 or 3 errors, while others take as many as 7 minutes and may make 25 or 30 errors. It will be noted that performance on this test involves the coordination and many of the same movements that are normally required in running an actual drill press.

## Clerical Tests

The tests that have proved most helpful in selecting workers for clerical jobs are (1) intelligence tests; (2) tests of clerical speed and accuracy; (3) tests of specialized clerical abilities, such as vocabulary, arithmetic computation, reading comprehension, and spelling; and (4) clerical trade tests measuring proficiency in typing, copying, and similar work.

The ninth revision of the Army Alpha Examination[10] is considered a particularly good intelligence test for the clerical situation, because it provides a separate measure of the individual's verbal facility and number ability, in addition to the intelligence score. Applicants with high verbal facility, provided other abilities are favorable, can be used to best advantage on jobs such as stenographer, receptionist, and report writer, where the ability to use words is a prerequisite. Those with high number ability can be assigned to accounting and statistical jobs, which demand good manipulation of figures.

The Minnesota Vocational Test for Clerical Workers is by far the most widely used clerical test. It measures speed and accuracy in checking names and numbers. The National Industrial Conference Board Report, March, 1941, summarizes the experience of many companies with this test with the statement that its "prediction ability for clerical workers is 35 percent better than chance." Several studies have shown, however, that this test is much more useful in selecting lower-level routine clerical workers than the higher-level office people where job success is more dependent upon ability to make decisions than upon clerical speed and accuracy.

[4] "Experience With Employment Tests," National Industrial Conference Board Report, March, 1941

[5] W. V. Bingham, "Aptitude and Aptitude Testing," Harper & Brothers, 1937, p. 152

[6] The Psychological Corporation

[7] Rensis Likert & W. H. Quasha

[8] Educational & Personnel Publishing Co.

[9] G. K. Bennett, R. A. Fear, *Personnel Journal*, May, 1943

[10] The Psychological Corporation

Good tests of specialized abilities, such as vocabulary, arithmetic computation, reading comprehension, and spelling are too numerous to mention. The Thurstone Examination in Clerical Work,[21] however, includes a considerable number of sub-tests of these specialized abilities, and is used in a relatively large number of companies. Great care must be observed in interpreting the results of these tests, because frequently it is not the total score that provides the basis for assignment to a particular job as much as the score on one or more sub-tests.

Standardized clerical trade tests, such as the Blackstone Stenographic Proficiency Test for Typing and Stenography, the Thurstone Examination in Typing, the Stenographic Aptitude Test, and the Stenogage Test, are available to qualified users. Many companies, however, prefer to give their own typing and stenography tests and, where these have been given under controlled conditions, they have often worked out very satisfactorily.

* * *

However valuable tests may be, they should never be used as the sole selection device. It must be remembered that they do not supply much information about the individual's work habits, ambition, ability to get along with others, and stability of character. All these factors must be evaluated by means of the employment interview. Someone has said that tests show whether the applicant *can* do the job but do not tell whether he *will* do it. How tests are being used by representative concerns—and can be employed as a tool of management in the major job of making the most effective use of manpower, not only today but under post-war conditions—is illustrated by the case studies in the following pages.

[21] World Book Company

## Aptitude Tests as Aids in Selection and Placement of Inexperienced Women—*Sperry Gyroscope*

The use of aptitude tests in the selection and placement of inexperienced women for factory work is a wartime development at Sperry Gyroscope Company, Inc. Before the war, machining and assembly work on Sperry instruments was performed by highly skilled mechanics.

As reported by J. H. Coleman, employee test supervisor, the testing program had to be designed to meet several problems simultaneously. At the start it was not possible to test for specific jobs. Tasks formerly done by one skilled man were in process of being separated into units, each of which could be mastered by one inexperienced woman. New instruments created different types of new jobs. As more men left for the armed forces, women had to take their places on the more difficult operations and in group supervisory positions. Finally, only a limited time in the employment routine was available for testing because there were so many jobs to be filled.

Factory work for women consists of two main classes—relatively routine tasks which can be learned quickly because they depend largely on manual or finger dexterity, and jobs of a higher degree of skill or specialization for which some systematic training is essential.

The problem, then, was to set up a battery of tests which, in a short testing period, would distinguish aptitude differences that could be used to assign women to jobs of varying difficulty. Proper placement on specific jobs would have to depend at first upon a consensus of empirical judgments until data were available to determine test standards. In any case, test scores are not used as absolutes but as additional evidence from which interviewers can decide upon the best possible placement of the applicant.

The first purpose of the testing program is to select those applicants who have a sufficient capacity to learn, which warrants giving them the training for specialization. A short verbal test of learning ability (standardized for adult industrial applicants) is used. A non-verbal test does not serve well enough to select personnel capable of

**Mistakes in the placement of women are minimized by Sperry's battery of six tests. Left, a test to determine near-point or work-point vision. A hand-tool dexterity test is shown at the right**

comprehending assembly operation sheets, reading detailed blueprints, learning the essential shop mathematics, reading verniers, and the like.

A shortage of machine operators prescribed the next two tests which, in combination, have materially improved selection of candidates for machine tool operation. One is a test of comprehension of mechanical principles (adapted for women). The other is a test of hand-tool dexterity which uses three pairs of small tools to dismount and reassemble three sets of four bolts and washers. They are PCI 30-W and PCI 51, respectively, in the Psychological Corporation Industrial Series.

The fourth test diagnoses the applicant's mastery of fifteen fundamental skills in arithmetic. The applicant who lacks many of these skills cannot learn the essential shop mathematics in the time available. This is particularly true of the applicant who cannot do short or long division with whole numbers, multiply or divide a fraction by two, change a fraction to a decimal, and point off the decimal in multiplication and division. The trainee is taught only the skills that she has not previously mastered.

The applicant who shows by her scores that she has little promise of even minimum success on the more difficult jobs is given the Purdue pegboard tests of manual and finger dexterity to determine her aptitude for routine assembly work.

The sixth test is not strictly an aptitude test, but it is vital to aptitude testing and to the selection and placement of personnel. Workers doing work to tolerances of a thousandth or a ten-thousandth of an inch must possess suitable near-point or work-point vision. This became evident when 20 percent of the applicants selected in six weeks to learn a special calibration job had to be transferred to less exacting work. Investigation showed each had defective near-point vision. Currently Sperry is adapting the Keystone Visual Safety Test.

The first advantage secured by this test saves time and money; no longer are new employees assigned to training for jobs they cannot learn because of inadequate vision. These vision screening tests also make it possible to avoid assigning an inexperienced applicant to learn machine tool operation when she lacks suitable depth or space perception. Such applicants can safely be taught routine assembly work but not machine tool operation, for without an adequate degree of depth perception they are prone to accidents and cannot machine consistently to close tolerances.

## Selection of Women—*Wolverine Tube*

The first step taken in the selection of women at the Wolverine Tube Division, Calumet & Hecla Consolidated Copper Company, Detroit, was to survey all jobs in the organization to determine those that could be handled by women with some changes in procedure. After this tabulation had been made, reports D. D. Decker, personnel manager, three tests were set up—for intelligence, temperament, and mechanical aptitude.

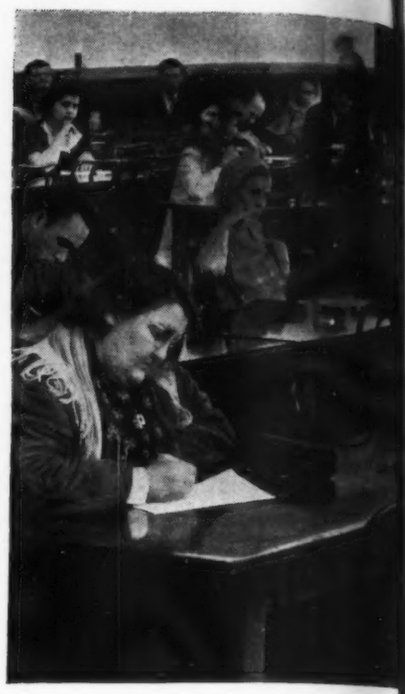
A sample group of 87 women were then tested to aid in establishing score standards for the various jobs. The intelligence test used is the Otis Self-Administering Test of Mental Ability: Higher Examination; the temperament test used is the Rohrer Personality Record; the mechanical ability test used is the MacQuarrie Test for Mechanical Ability.

Each applicant is carefully tested and interviewed prior to employment. The use of the standards set up in connection with tests has enabled the company to select and place female employees with a high degree of accuracy. About one of five tested is rejected. Of those selected and placed on a job, only two have proved unsatisfactory after a thorough training. The training used is on-the-job training recommended by the Job Instructor Training Program of the Training-Within-Industry Division of WMC.

## Placement Tests—*Caterpillar Tractor*

All applicants who apply for shop work at Caterpillar Tractor Company, Peoria, Ill., are invited to take two tests —Wonderlic's Personnel Test and Bennett's Test of Mechanical Comprehension. These tests are not given to eliminate anyone, or to keep anyone out of employment. They are used merely to do a better job in placing the applicant where he will be a satisfied, valuable employee doing the type of work he likes and is qualified to do best.

Test results are one more tool to assist the personnel division in doing a better job in placing the applicant. When the final selection for employment is made, the interviewer has before him the detailed application, the results of a final and thorough interview, references from former employers, and the test results. Many times there will also be a confidential investigation if the applicant is to be considered for a key position. All



these factors are considered, no one factor decides where the individual should be placed.

The tests are given to a group of applicants at 7:30 each morning except Sunday. The applicants are seated in a large testing room, and the standard instructions for the tests are read to the group over a public address system. When the tests are completed, the applicants are given the opportunity to fill out a statement of qualifications, which is an application in brief. The same morning the applicant has a brief interview with an employment interviewer. After the applicant's work history has been carefully checked and the tests have been scored, the applicant is called back for a final detailed interview.

## Placement of Mechanics—*Air Service Command*

To place each of the thousands of civilian mechanic recruits into the specialty for which he is best qualified, a special battery of aptitude, intelligence, and dexterity tests have been worked out by the Air Service Command at San Bernardino Air Depot, where fleets of war planes are maintained and repaired.

Air Service Command has 19 different types of aircraft mechanics covering phases of the over-all ASC job of handling airplanes of 256 different models, 157 different engines, and more than 1000 different accessories. Because the work to be done by an individual mechanic is so limited and

**Every morning at 7:30 o'clock, applicants gather in the Caterpillar plant to take two prescribed placement tests. Test results and application data aid interviewers in assigning new workers**

so specialized, the Depot's technical training officer, Maj. Homer D. Fetty, has developed a battery of tests to cover: Carburetors, aircraft disassembly, ignition, engines, fabric and leather, hydraulics, instruments, machine shop, paint and dope, drafting, wood shop, Army-Navy standards, sheet metal, welding, wire cable, fuel and oil systems, aircraft electricians, brakes, and measurements.

Preliminary over-all tests include the Otis Intelligence, Bennett Mechanical Comprehension, Wisconsin Lathe, Drake Accuracy, and Snellen & Yaeger Vision tests. Following these tests, the mechanic recruit is given a series of 4-hour "experiences" in each of the specific fields, based on an actual manual tryout on a typical work experience taken from the field in which the worker is being tested.

For example, in the fuel and oil systems division, handling aircraft tubing is the major activity. Here a sample tryout experience has been developed in which the worker cuts, bends, flares, and fits a piece of tubing according to directions.

On the assumption that people coming into this experience are without previous mechanical knowledge, the instructor gives a detailed explanation of the proper use of the tools involved, presents a simple but comprehensive explanation of the job, and gives a demonstration, before the worker is called upon to perform.

The instructor rates the worker on specific steps in the job and on probable ability to take successful training and perform effectively.

On the basis of the worker's preference, his relative performance, and his rating in the battery of general tests, he is assigned to take an advanced course in the field for which he displays the greatest potential aptitude. This careful selection in most cases lands the worker in the field he likes best and in which he performs best.

## Wage Earner Test—
## *Thompson Aircraft*

A single test for hiring all hourly rate employees is being used at Thompson Aircraft Products Company, Cleveland. The test is the Wage Earner Test developed by Joseph S. Kopas of Fenn College, Cleveland. As described by W. R. Ryan, Jr., assistant personnel manager, the test consists of seven parts:

**1. Mental Alertness.** This is a series of diagrams of parts of a mechanical nature, such as pulleys and gears. The applicant has to indicate the direction of rotation. This checks ability to think in mechanical terms and to create mental images of mechanical operations.

**2. Math and Science Background.** This test consists of a number of elementary problems in addition, multiplication, decimals, and fractions. Simple science questions are included. Answers are either right or wrong.

**3. Personal Characteristics.** Questions ask how the people with whom the applicant has daily contact have impressed him. The answers tend to show how well the applicant will get along with his fellow-workers, and whether he is an introvert or an egoist.

**4. Interest in Routine Work.** The applicant is given the choice of one of two activities of more or less direct opposites. His choices tell whether he likes routine work and is adaptable to specialization, or prefers variety.

**5. Emotional Stability.** Half of this test is made up of questions about the applicant's emotions and moods, to which he is to answer yes or no. The other half has statements of a debatable nature to which the applicant answers in agreement, uncertainty, or disagreement.

**6. Ambition and Drive.** Three free-time activities are listed. The applicant is asked to choose the one in which he spends most of his leisure moments. Selections tell to what extent he is interested in self-improvement and advancement.

**7. Mechanical Coordination.** Two screws and four bolts are fastened to a board with nuts. The applicant is timed while he loosens the nuts with wrenches, reverses the bolts with his fingers, and then tightens the nuts again with wrenches. On the screws, he uses a screwdriver and wrench to loosen, but only screwdriver and fingers to tighten. The time it takes to

do this tells just how well he can make his hands work together on mechanical objects and with tools.

These tests have been found to be fairly indicative. The results have been checked against the progress of new employees both in the learner training school and on production jobs. Successful shop workers are almost always in the higher test grade brackets.

## Tests for Methods Men—*Westinghouse*

For more than a year the Westinghouse Electric & Manufacturing Company has used a special training program to supply methods engineers and motion analysts for use in the various plants and divisions. More than 200 men have been successfully trained. Thus far each one selected for training has borne out the indications shown by the prehiring interviews and aptitude tests.

If the record of the applicant indicates previous experience or education that would be helpful in this field, or if he wishes work of this nature because of the work itself and not merely for a job, he is given an interview. The interview is conducted by a trained supervisor who rates the applicant's general appearance and personality, and gets a more detailed picture of his aims, abilities, and experience through intelligent questioning.

If the applicant is up to standard, he is given three tests to confirm the impression obtained in the interview—a mental aptitude test, an arithmetical reasoning test devised by the time and motion study section, and a personality test. If the results indicate that the applicant shows possibilities of becoming a good methods man, he is admitted to the training group.

## Tests for Promotion—*Kimberly-Clark*

Traditional at Kimberly-Clark Corporation, Neenah, Wis., is the policy of promoting from within. People are hired not so much for "a job" as for "the Corporation."

This policy has influenced the testing program in two ways, say C. E. Jurgensen and J. C. Simonich of the industrial relations department. First, it has been advisable to test aptitudes rather than an already developed skill, because training is particularly important when promoting from within. Second, tests are used more for employee counseling and placement than for acceptance or rejection of applicants.

With emphasis on the testing of employees rather than applicants, it becomes increasingly important that employee attitudes toward the testing program be highly favorable. This result has been obtained by using tests that appear to be as practical as they actually are, and by using test results in such a way that employees realize they gain rather than lose when tested.

Practical appearance has been obtained by constructing or adapting tests to fit the specific need, using terminology and other factors that relate directly to the paper industry. For example, from an arithmetical point of view, it makes no difference whether a man adds cows or rolls of paper. From the Kimberly-Clark employee's point of view, however, the first is "theoretical and impractical," whereas the second is highly practical.

When the program was started four years ago, procedures included a discussion of test results with each person. This procedure has since been followed, and has done much to obtain employee support. Each employee is told what his strong and weak points are and how he can overcome his weaknesses. Many of the tests are specifically designed to facilitate such discussions.

So far as possible, applicants are not told that their test scores are too low for placement on the type of job in which they are interested. Emphasis is placed on the relativity of success in various jobs, and on the importance of getting into an occupational field in which one is most apt to be successful and happy. Test administrators point out that all persons have assets and liabilities, and that it is frequently better to strengthen existing assets than to attempt to overcome liabilities. The applicant is thus encouraged to decide for himself the type of work he should enter.

Discussion of employee test results has an excellent effect on employee morale. Instead of thinking that the personnel department is trying to keep them out of desirable jobs because of some prejudice, employees believe management is interested in them as individuals and that they have been aided in making a wise decision which will be important for their future success.

Test administrators are trained in the viewpoint that test results, though important, are nevertheless only one factor to be considered in hiring, placement, and upgrading. Tests are therefore used to supplement rather than to replace other personnel techniques.

## Standardized Interview Plus Tests—*Swift*

For the interviewer, judgment that is based on as much factual information as possible is fundamental to the whole problem of selection. About a year ago Swift & Company, Chicago, with the aid of a consulting agency, began a program that included the development and refinement of the following techniques:

**1. Standardized Interview.** The standardized or "controlled interview" is used to secure a well-rounded picture of the applicant's experience, motivation, personality make-up, and other environmental aspects (such as domestic situation) which have a bearing on his ultimate vocational success.

**2. Personal History Analysis.** The most desirable age, education, marital status, and kind of experience are determined for each position. Each of these items is given a weight in proportion to its ability to differentiate between success and failure on the job. From a total of these factors a critical score is set which serves as a further guide to the interviewer.

**3. Psychological Tests.** The use of a battery of tests that have been scientifically validated, provides the interviewer with still another tool to aid him in making the final decision.

In the work with psychological tests the experimental approach has been used. All tests were tested before they were finally accepted as valid devices for selection or placement. Two general methods for "testing the tests" may be followed:

1. Test all new employees at time of hiring, file results, and at a later date determine the relationships that exist between test results obtained at time of hiring and subsequent success on the job.

2. Test present employees and correlate the results against ratings and/or whatever other criteria of desirability in an employee may be available.

Each of these methods has its own particular advantages and disadvantages; a long-term testing program should make use of both.

Swift began by "testing the tests" on present employees. A letter signed by the office manager was personally addressed to each employee to be tested. It assured him that the data obtained would be confidential and have no bearing on present or subsequent jobs.

Each occupational group to be tested was studied, and a psychologi-

**On the "assembly line" at AC Spark Plug, applicants are moved right along from one test to the next, while their abilities are being noted, and their reactions checked, by trained examiners**

cal job analysis was made of the work it performed. This consisted of determining psychological traits and qualities that appeared necessary for success in each type of work. On the basis of this preliminary analysis, certain tests were recommended for trial. They included measures of intelligence and personality, together with special proficiency tests (dictation for stenographers, for example) and special aptitude tests for other positions. Test results were correlated with ratings obtained on each person, in order to obtain indications as to which of the tests were most useful. On the basis of this information, tentative standards have been set.

The initial battery of tests required approximately 3 hours for administration. The tentative battery takes about 1¼ hours. These tests are now being administered to all new applicants, with the understanding that those who do not meet the minimum standards will not be rejected, provided they appear satisfactory on other grounds. These new employees will be followed up at a later date to determine their success on the job, and this rating will serve as the basis for the final validation of the tests.

## Tests That Come After Hiring—*Ford*

Because trained workers are so scarce, and the demand is so great, employees at the Ford Motor Company are hired first, then tested for aptitude for specific jobs.

In testing for jobs as clerks at the Rouge and Willow Run plants, the employee fills out an information card, giving details of identification, school education, and practical experience. Tests given include mental alertness, personality, typing, spelling, copying, simple arithmetic, and a checking test.

Tests also are given in upgrading an employee from one job to another. Truckers who wish to become clerks are given reading tests, counting tests, and examinations in tallying, simple addition, subtraction, copying, checking, mental alertness, and simple filing.

Men and women hired as riveters are given tests for hand and finger dexterity. These include tests in which they are timed as they place rivets in holes in a rivet board, and a test in which they determine the size of rivets by feeling, rather than by sight.

These tests were started June 15, 1942, and since that time approximately 10,000 workers have passed them. Foremen agree that the workers selected in this way are superior to those placed on the jobs without such examinations. Similar testing is done at the Ford Highland Park plant, where California capacity test, California personality test, pegboard tests, and spatial tests (to determine the worker's visualization) are given.

## Selection of the Right Tests—*American Type*

Early in 1941, American Type Founders, Inc., Elizabeth, N. J., was unable to hire all the skilled help required in the shop, so inaugurated a program for training machine operators, assemblers, and inspectors.

While management was considering how to select these green employees, the State Employment Office telephoned that it had representatives in Elizabeth from the federal government who would like to utilize the plant as a laboratory for selection and testing methods. The company lost no time in taking advantage of the offer.

The proposal was that the company should select 50 or 60 skilled mechanics. This group was to be given a battery of 37 tests. From those tests the ones applicable would be used in testing applicants. The employees enjoyed the experience, and the reaction was excellent.

Three of the 37 tests were selected to be used in selecting employees for the training program. All the details were worked out and the tests were given at the U. S. Employment Office. Results were exceedingly good.

At that time inexperienced help was plentiful, therefore by these tests the company was able to select the top third of the applicants. Results were quite remarkable, and it was found that most of the employees who passed in the top third of the test picked up the training much faster and were much more adaptable than those taken on without the test.

# HOW TO MAKE THE MOST EFFECTIVE

## STEP 3 Adopt Tested

**Caterpillar Tractor trains women in groups of nine to twelve as engineering and tool design tracers and detailers. Course lasts five weeks. Trainees get a working knowledge of drafting, physics, tool-room practice, shop procedure. They have plenty of chance to practice under shop conditions**

# SE OF MANPOWER

# Training Systems

THE SPEED and efficiency with which large industries converted from peacetime to almost 100 percent wartime production, in huge volume and in the shortest span of time on record, are the result largely of two fundamental factors, capable executive and technical leadership, and sound, rapid, effective training. The plants that have done the best training have made the best records. This fact is of significant portent in the coming peacetime reconstruction.

## Trends in Training

Training, like everything else, has undergone remarkable changes as a result of emergency needs:

1. The attitude of today is "show them how."

2. Training time has been cut to the limit. Ten hours' training now does the work that used to take 50 hours or more.

3. Scope of instruction has been concentrated on what is absolutely necessary. Training, not educating, is the object.

4. Grade of instructors has been vastly uplifted. Formerly, many could *do* but not *teach*. Now, all the trainers are taught how to teach.

5. Outmoded and impractical theories on selecting applicants are being thrown to the winds. Most people can be taught to be efficient if properly sized up, assigned, and trained by competent instructors.

6. Women have been found to be highly capable, when correctly trained, on jobs that were formerly labeled "for men only."

7. Foremen and supervisors have found out that they have to learn how to train, and that, if they are not good teachers, they are not so good as supervisors.

8. Management has learned that the plant must be a training ground as well as a production center. The best workers are those given organized, practical, systematic, condensed, and efficient training.

Out of this picture the framework of modern industrial training can be blocked. The objective is better to prepare individuals to do specific jobs within the organization. Industries are not universities and they cannot carry on broad educational programs for general development of the working force. But they can train persons to do work, or do it better, and they can train capable employees to go into higher jobs.

Persons to be trained today constitute practically the whole range of the working force. Even experienced men and women on many jobs must learn the changed methods brought about by technical progress in new materials, improved machines, and better processing procedures. The kinds of training needed vary with the age, experience, aptitudes, and jobs of the trainees. Invariably the emphasis must be on the specific and not the general in subject matter. The following tabulation blocks out roughly the groups into which available kinds of training may be classified:

1. Inexperienced younger employees: Vocational, trade extension, cooperative, and apprentice training.

2. New employees, regardless of age

or experience, who must be taught jobs: Pre-employment or vestibule training, on-the-job training by a worker or by an experienced trainer, training of women workers.

3. Employees with some experience and perhaps educational background: Refresher training and upgrading.

4. Engineers or others technically qualified: Engineering and technical training, graduate engineering.

5. Supervisors and foremen: Foremanship, supervisory, and leadership training; Job Instructor, Job Methods, and Job Relations Training (sponsored by the Training-Within-Industry (TWI) Division of the War Manpower Commission).

6. Executives: Management and organizational training.

## Agencies for Training

There are a number of tested training programs available which may be adapted by individual companies, or applied with the aid of the agency which has developed them.

The agencies from which aid in organizing and conducting the training may be secured as as follows:

1. The training department of the individual plant. Many companies have well-organized and capable staffs regularly engaged in training workers, instructing supervisors, and carrying on other training.

2. A central training agency of the industry. The Manpower Division of the Automotive Council for War Production, for example, offers aid to plants within its field.

3. Local schools—high, technical, vocational, and evening high.

4. Colleges and universities. Training is available through (a) resident day or evening courses; (b) special tuition-free courses of 40 to 60 hours, sponsored by the government and running for about 7 weeks; (c) tuition-free day courses organized under the Engineering, Science, and Management Wartime Training (ESMWT) program of the U. S. Office of Education; (d) courses given by university extension divisions at colleges and in industrial centers; (e) special courses conducted within plants by colleges, either individually or under government auspices, such as ESMWT; (f) tuition-free summer courses in engineering or other technical fields for women high school graduates, especially those who have studied mathematics, physics, or chemistry.

5. Government-sponsored training. This includes (a) the special courses mentioned above; (b) TWI courses already cited; (c) vocational training for war workers, directed by the Federal Board for Vocational Training and operating classes either in public schools or within plants, even supplying instructors and classroom aids; (d) aid in apprentice training.

6. Training through private agencies. This includes (a) resident trade-school courses in welding, machine shop practice, etc.; (b) training given by certain consulting engineering firms, or by special engineering and management organizations set up particularly for training in production management, time and motion study, personal relations, etc.; (c) non-resident training offered by home-study or correspondence schools.

Methods of instruction vary with the kind of training and the agency giving it. However, all worker-training programs tend to concentrate mainly on immediate results. First, the principles and fundamentals are explained briefly to the trainees to show what the object of the training is, of what the training consists, and the basis upon which it is founded. The rest of the time is used to demonstrate what has to be done, why, when, where, and how. As soon as possible the learner gets a chance to try his hand at the work, and the instructor watches, corrects, and gradually gets the worker "on his own."

Length of courses is cut to the absolute practical minimum. In training job instructors, for example, courses requiring up to 120 hours were bypassed and one covering only 10 hours was set up under the TWI program. The results surprised even the pioneers who undertook this daring step in industrial education.

## Starting the Program

In undertaking a training program, it is important to place a highly capable man in charge of the work, if one is not already appointed. It is more important to have at the head a good organizer, teacher, leader, and executive, who has an intimate knowledge of training methods and human nature, than a man with a technical knowledge of processes, materials, and skills, or one with only personnel experience. Those who do the detailed training, however, should know the ins and outs of the various jobs as well as how to show others the way in which to do them.

As a result of its studies, the Manpower Division of the Automotive Council for War Production recommends the following procedure in setting up a training program, after a capable director has been appointed:

1. Tabulate the entire working force according to proved skills.

2. Determine the needs, according to skills, to complete the force at its peak.

3. Check number of available workers against needs in each skill.

4. Group the skills according to nature and arrange in decreasing order of skill. Meet shortages of workers by upgrading. Start inexperienced workers in low skills and train for advancement. Meet surpluses of workers by retraining the extra workers for other skills.

5. Plan training schedules to meet production schedules so that newly trained or retrained workers will be available when needed.

6. Estimate and allocate training costs.

7. Appoint instructors who have aptitude and knowledge in the jobs they teach and who can impart this knowledge effectively.

8. Review Selective Service replacement schedules by job classification to determine training needs.

## Supervisor Training

The requirements of supervision extend beyond merely physical accomplishment because supervisors must deal with workers, represent management, and carry responsibilities covering employees, equipment, materials, methods, and the general running of a unit of the plant.

Sometimes the supervisor must be trained in the technical and operating of new jobs which he must supervise in his section. He will then need instruction of the same kind as given to the worker. More generally, if he is a beginner, he needs in instruction in some or all of the following subjects: Industrial relations, handling of grievances, leadership, training and direction of workers, interpretation of company policies to workers, production planning, production control, machine utilization, time and motion study, job analysis, methods of improvement, waste reduction, safety, plant housekeeping.

For supervisors who are experienced in directing workers and running a section or department, the conference method of training is best adapted. Emphasis is placed on leadership; the discussions center on existing problems; and demonstrations and the case

**In advanced riveting course at Armstrong Cork Company, trainees practice on stands that can be adjusted to simulate work positions**

method are effective mediums for arousing interest and conveying ideas.

There are good courses available on foremanship, and the extension divisions of many of the colleges and universities are well equipped to carry on instruction of this kind.

## Training-Within-Industry

One of the most spectacular new developments in training has been that brought about through the Training-Within-Industry Division of the War Manpower Commission. The war emergency left no time to convert inexperienced workers and learners into machine operators and skilled mechanics under leisurely peacetime methods. Raw labor had to be made into capable producers with a few hours of training instead of the usual scores or hundreds of hours. Thousands of instructors or teachers had to be discovered and trained in short-cut methods of getting information across and showing inexperienced men and women how to perform jobs correctly and efficiently. The practical program toward this end was evolved under the direction of Glenn Gardiner, as TWI district director in New Jersey.

**Job Instructor Training.** The plan began with Job Instructor Training, and 10 hours, in five 2-hour sessions, were allotted as the time in which to train groups of instructors to show others how to do jobs. The instructor is shown that he gets ready to teach a job by deciding what the learner must be taught, by having the right tools, equipment, supplies, and materials ready, and by having the workplace arranged as the worker should keep it. He is then taught to proceed with the following four steps:

1. Preparation of learner to put him at ease and arouse interest.

2. Presentation of the operations and knowledge, slowly, clearly and completely, checking to see if the learner really is learning.

3. Performance try-out by having the worker do the job and correcting his errors until he really knows.

4. Follow-up by checking the worker's performance and tapering off to leave him "on his own."

The purpose is to develop in the supervisors, foremen, and other instructors the ability to put their "know-how" over as quickly as possible. The principle expressed is, *if the learner has not learned, the teacher has not taught.*

In the first session, the instructor sets forth the idea and the principles involved. The other four sessions are devoted to drilling and teaching the members of the group, who are themselves required to demonstrate how they would teach some job to a learner.

**Job Methods Training.** With this program well under way, and the realization that more production could be secured only by more effective use of the men and machines available, JMT plan was developed under the direction of Clifton Cox, of the New Jersey district staff, and now Washington Headquarters representative of WMC.

JMT is an intensive 10-hour training program specifically designed to help department supervisors, foremen, and lead operators produce *greater quantities of quality products in less time* by making use of manpower, machines, and materials *now available.*

In JMT the key question about any operation is "Why is it necessary?" The steps in handling any methods problem are:

1. Get all the facts in the case.

2. Weigh them and decide on possibilities of improvement.

3. Take action on getting a new plan developed.

4. Check results secured.

In the first session, the instructor outlines the fundamentals and discusses the four steps, as given above, in methods improvement. In the other four sessions the group members bring in actual jobs on which they have worked out improvements, and demonstrate what they have done.

JMT has been given to over 30,000 supervisors in the United States, and it is estimated that ultimately it will be extended to 500,000 men and women in supervisory jobs. This spring, Cox set up the JMT program in Canada at the invitation of the Department of Labor of the Dominion.

Savings reported as a result of JMT have been phenomenal. In several manufacturing plants they have been over $500,000.

**Job Relations Training.** The third stage in the TWI program is Job Relations Training. Since supervisors deal with workers as human beings, they must learn how to handle personnel problems. The first session is given over to fundamentals, and a case

is presented to bring out the four foundations of good relations:

1. Let each worker know how he is getting along.

2. Give credit where due.

3. Tell people in advance about changes that will affect them.

4. Make the best use of each person's ability.

The four remaining sessions are given over to analysis of problems brought in by members of the group. As in JMT the essentials stressed are: Get the facts, weigh and decide, take action, and check results.

The success of the entire TWI program is based on a few elementary considerations:

1. Time is important. In each case the training must be completed in 10 hours.

2. Arouse interest in the person being trained. Put him at ease. Find out what he knows and use that as the basis.

3. The plan hinges on instruction in how to *instruct*. The usual on-the-job "learning" is wasteful and ineffective.

4. Know what to leave out. The instruction is more effective if not inclusive but exclusive. Leave something to the imagination.

5. Pare down material to the bone, outline it, and make a "blueprint." The person who receives the training then can use the outline later in training others.

6. The obligation to train others rests on the supervisor or foreman. He knows this, so responds to this new method of training.

## Training Women

Upwards of 40 percent of the women workers in the United States will be engaged in war industries by the end of 1943. In the last few years, by proper breakdown of jobs, use of materials handling equipment for heavy lifting, and good training, women have been fitted for jobs done before only by men. Neither the training of these women, nor getting them to do the work properly and at standard or better rates of production, has raised any insurmountable problems. In fact, many times women have beaten the records of men.

Already over one-third of the major war occupations can be filled by women, and they can be quickly trained for another third. The opportunity to increase employment of women apparently hinges mainly on training, to which management finds they readily respond.

For rapid training, and use of the least training facilities, simple methods are needed. Lodge & Shipley Machine Tool Company, for instance, has reduced its program of training women to a four-point plan in preparing them for machine-shop work. The plan covers use of a 6-in. scale, reading a decimal chart, use of a micrometer, and reading mechanical drawings. Micrometer instruction is given on a large-sized model to magnify the reading so that the effect of a slight turn can be readily understood.

Women workers take most readily to repetitive operations. They can be easily trained to operate most kinds of machines of small or medium size, to inspect, to do repair work, to weld, and even to run heavy equipment such as large planers and overhead traveling cranes.

## Executive Training

Today's demands upon executives crowd organized training well into the background. It cannot be safely neglected, however, because plant problems are increasing in difficulty and peacetime reconversion will call for the best brainpower and technical ability to carry on when major readjustments in plant and operations, and the rebirth of competition, double the present perplexities.

A considerable amount of executive training, especially nowadays, is of the "on-the-job" variety. In place of conferences for the purpose of training, there are many conferences for the settling of practical problems in regard to materials, equipment, methods, personnel, production, costs, and other operating factors. Executives, moreover, must decide—right or wrong. This necessity, in itself, brings with it a valuable training.

But with all the new problems in the offing, complicated by new difficulties in labor relations, the executive himself cannot afford to slip back in his formal training. This training must be condensed. Through conferences, reading, participation in professional associations, and other means, he must condition himself to improve his methods of management, and keep pace with the demands of the times.

## Apprentice, Production, Engineering, and Labor Training Program—*Goodyear*

The training program operated by The Goodyear Tire & Rubber Company, Akron, is so extensive and complete that it embodies an accredited high school course along with advanced classroom and shop training that is equivalent to a college degree in engineering.

A recent announcement by the Ohio department of education designating Goodyear Industrial University as a first-class high school gave new impetus to the Goodyear apprentice course. Under the new rating, it will be open to boys who have two full years of high school credits, who are mechanically inclined, and who wish to receive training as machinists, electricians, carpenters, pattern makers, blacksmiths, or sheet metal workers.

The course includes a maximum of four years of shop and gymnasium training, with three years of scholastic study. It is open to youths between 16 and 20 years old, and preference is given to sons of employees. Students spend 8 hours a day in the shop and 2 hours, 4 days a week, in the classroom. Those who enter the course after completing two years of high school receive their high school diplomas through the university along with a journeyman mechanic's rating.

For a number of years Goodyear has operated production and engineering squadrons. Entrance requirements for the production squadron are that candidates be between 21 and 26, in good physical condition, and weigh at least 150 pounds. At least a high school education is required. Preference is given to candidates who are Goodyear employees. The course is of two years' duration. Those who successfully complete it may take a third-year postgraduate course including both shop and school work. Upon successful completion of the third year, training may continue in shop work for a year, contingent on satisfactory placement. Production squadron men work in virtually every job in the factory during their training period, and are paid at a starting rate of 86 cents per hour for the time spent in shop, school, and meetings.

The engineering squadron operates in practically the same way, except that applicants must be either graduate engineers or journeymen with at least high school training.

A labor training program, instituted only two months ago, is operated under the director of training by twelve labor training foremen.

These foremen received Job Instructor Training, and are responsible for training every new employee in

**Boy who enters the course for apprentice mechanics at The Goodyear Tire & Rubber Company completes high school training under competent instructors and gets diploma along with journeyman's rating**

their divisions, as well as for retraining old employees.

The labor training foreman keeps in close touch with the new worker for three weeks—or until it is evident that the worker is completely acclimated to the job. Employees leaving the company are interviewed by the labor training foreman, and case histories are written to provide information that may prove helpful in the future.

## JIT, Refresher, Co-op Courses—*National Cash*

In some departments, the National Cash Register Company, Dayton, provides "on-the-job" training. This usually means placing an unskilled man under the supervision of a skilled mechanic, who has charge of the training and is known as a job instructor. At other times a number of unskilled men are under a single skilled operator who is charged with their training. This type of training is becoming increasingly difficult because of the lack of skilled operators who can be used as supervisors.

This company is conducting classes daily in Job Instructor Training. These 10-hour courses are given during working hours. Members of supervisory groups are required to make breakdowns of the jobs in their departments, for use in teaching new employees.

For 40 years, NCR has conducted educational classes for employees, usually at night. When war broke out all courses were eliminated except those that have a direct application to war production, such as machine shop practice, blueprint reading, and shop mathematics, as well as reading micrometers and precision gages. Classes provide opportunity for employees to review these subjects, which is most helpful in upgrading them to higher skills. Precision gage and micrometer reading classes are held during working hours; the others in the evening. Employees may volunteer for the classes, or when they are being considered for upgrading, a refresher program is suggested to them.

For many years NCR has sponsored a cooperative program of education, through the University of Cincinnati, for students who co-op on a 7-week basis, and with the local vocational high school, for students who co-op on a 2-week basis. A standard rate schedule is maintained for each group. A number of the company engineers were trained through the University of Cincinnati co-op program.

## Four Point Training Program—*Carnegie-Illinois*

Between December 7, 1942, and April 30, 1943, 70,000 new persons were employed by Carnegie-Illinois Steel Corporation, Pittsburgh, because of expansion, increased production, and losses of experienced workers to the armed services. Training these 70,000 new employees and improving the skills of old employees have been done through a four-point program.

1. Careful initial selection
2. Improvement of instructing skills through JIT
3. Follow-up of JIT with individual supervisors
4. Conference training of supervisors to insure recognition of their training responsibility

It is obvious that the training job is made easier if selection tests are used to insure that only men and women with the essential capabilities for the job are turned over to supervision for training.

The accomplishments of the war production program have amply demonstrated that a sufficient number of skilled instructors is one of the foundation stones for adequate on-the-

job training. Beginning with a nucleus group, Carnegie-Illinois has trained 5000 job instructors. Included are both supervisory and non-supervisory employees. For the supervisory group JIT is a part of their regular job responsibility. The non-supervisory group is composed of men skilled in their particular jobs who are trained as job instructors and subsequently given training assignments as the need arises. During the time of their training assignment, these non-supervisors have the payroll title of job instructor. Currently, this company is using about 500 of these non-supervisory men as job instructors.

To aid in the discussion of problems in supervisor conferences, the company has prepared two sound-slide films. "Divide and Multiply" and "How to Break In a Job Instructor." "Divide and Multiply" takes the approach that "where there is a production problem there is usually a training job to be done." In the film, supervisors are shown how to "divide" a production problem—how to break it down into elements so that the source of the difficulty is exposed.

## Supervisory Training—*Colonial Radio*

The need for additional supervision at Colonial Radio Corporation, Buffalo, dictated the initial training program requirement. An instructor was selected, and a conference type of supervision training program prepared. Trainees were chosen from the outstanding key men who were not engaged in supervisory work. They were informed by the president of the company of their selection and of the purpose of the training, and were urged to cooperate both for their own benefit and for their greater usefulness.

The course was boiled down from an original 24-week curriculum to a 12-week program, each session lasting two hours. Training was done during regular working hours. Selected key men were spread over the several departments in order not to handicap any one department too severely. Subjects covered during the training period included: The foreman as a business manager; how to train workers; maintaining discipline; safeguarding the worker; practical psychology for foremen; planning; materials handling; waste elimination; wage incentives; self-management.

Two separate classes of 35 employees each were conducted. Ninety percent of these trainees are now in supervisory positions.

## Job Methods Training—*Wilson & Company*

A typical experience with TWI, and especially with JMT is reported by Harry J. Williams, vice-president in charge of plant operations at Wilson & Company, Chicago meat packers. This company has used the entire TWI program, and up to June 28 had given JIT to 420 supervisors in the Chicago plant, to 1008 in all plants. JMT had been given to 168; is to be given to 400 all told in Chicago and to 450 in other Wilson plants. JRT had at that time been given to about 100 supervisors.

Proposals for improvements submitted by the 168 supervisors who had taken JMT totaled 152, of which 70 were in operation. Others required further study to perfect or adapt; still others had to be shelved.

Proposals related to problems of wartime operation—for example, a new clamp for closing unwieldy export packing boxes, hoppers for feeding salt into these boxes on the packing line, improved packing of ground beef for the Army. In most cases there was manpower saving, better utilization of present equipment, and last but not least, improvement of the product itself.

The principal value of JMT has been to make line foremen, supervisors, and leadmen conscious of the possibility of improving and simplifying their wartime jobs. The company believes morale has been raised to the point where supervisors are no longer so conscious of the limitations imposed by the need to use less skilled help, and by the impossibility of purchasing new equipment.

## Cooperating With Government and Schools to Train Time and Motion Study Men—*Goodrich*

The necessity for increased productive performance; the desirability of increasing wages at no increased cost through incentive plans; and the introduction of new war products and methods, have created an extreme need for trained time and motion study personnel, says S. L. Wansky, manager, time study and standards, Aeronautical Products Division, B. F. Goodrich Company, Akron.

Universities in industrial communities have an excellent opportunity to serve industry with the aid of industry itself. The solution of the problem resolves itself into a triangle. One side is the government-sponsored Engineering, Science, Management War Training approach, administered by a university with necessary qualifications and facilities. The other side is formed by a specific need—a course of instruction designed to meet the need based on experience and expedience.

The base is the industrial key to close the gap in obtaining hard-to-get pre-trained personnel. By serving as a part-time instructor in the evening session or adult education division, the professional employee in industry can provide basic essential training.

This pattern was followed in setting up an ESMWT class in time and motion study at the University of Akron. The outline and subject material were prepared with a close knowledge of requirements and received government approval.

The course is much like a yard engine. Does it deliver the finished product? No, but it does get the car over the hump. It is not possible to turn out fully trained and experienced time study engineers through schooling alone. It is possible, however, to provide sufficient background, technical data, and experience to reduce the training phase to a minimum.

Out of several sessions in the last two years at least a dozen men have been promoted to time and motion study work in their respective plants. Others, new in time study work, have, through instruction received, become more proficient sooner.

The results are convincing. This type of program is an excellent aid for development of time study personnel. It reduces learning time and develops a background that might be overlooked in the haste of industrial training only.

## School for Members—*Woodward Governor*

The Woodward Governor Company, Rockford, Ill., has inaugurated a plan whereby each employee ("member," in Woodward terminology) goes to school three hours each week on company time. Two of these hours are devoted to shop practices, technical films, explanatory lectures, brush-ups on the use of instruments, and other subjects that will enable the shop worker to improve his production. This course is one of general machine shop practice, and, although it may be an old story to toolmakers, it serves as a valuable review to them, as well as an elementary exposition of machine shop methods to the newcomers.

The usual procedure is to take one tool or one operation as the subject of a series of school periods. First, visual learning sheets are distributed ahead of time for the members to study. At the following meeting, a chalk talk on the topic is given, at which time questions may be asked. Next, movies are shown which further explain the operation under study. After this procedure, each member is expected to fill out the visual learning sheet, and discuss it completely with his foreman.

The third school hour is given over to a discussion of external affairs and matters of national and world importance. These discussions are led by Irl C. Martin, president and general manager, and all members are urged to take an active part in the proceedings. Motion pictures released by the War Department are often shown at these classes, articles are read which attempt to show the trend of affairs in the world today, and at times prominent speakers are invited to lecture. Also at these sessions any announcements relative to company policy or welfare are made to all members.

Three classes are held each day. Night shift workers have their class after they finish their work in the morning; day shift employees have theirs before they leave at night; and the 3 to 11 shift has its school before it starts work in the afternoon. In this way the company auditorium is never too crowded.

This school for members is a relatively new project, but even thus far has shown decided evidence of stimulating workers' interest in their work, and providing them with the necessary instruction which will enable them to put out more work of a higher quality. In addition, their active interest is being aroused in the affairs and vital problems facing the world today.

## Quick Training on One Machine—*General Electric*

The 42-year-old 4-year apprentice training course at General Electric Company is a war casualty, and in its stead the company is conducting a "learner training" course designed to teach green workers in eight weeks how to operate one machine.

Most of the students are girls. They range in age from 18 to 45; in background from housewives, shop clerks, and beauty parlor operators to some without any work experience.

The course is given in two shifts: 7:30 a.m. to 4 p.m., and 4 p.m. to 12:30 a.m. Students put in a 48-hour week, and are paid 56½ cents per hour with time and a half for Saturdays. There is one instructor for every twelve learners, which permits close supervision of all work done, as well as adequate instruction

Learners enter the course singly, not waiting until a group forms. At the outset they are given a pamphlet entitled "Safety Regulations for New Employees," the first part of which is intended to acquaint the beginner with the course and its objectives. It then explains that there are always potential hazards in a machine shop, and lists the safety regulations for all employees.

Students can read the booklet thoroughly in 10 to 15 minutes, and after they have finished they are asked to sign a small card certifying that they have read it. This helps to impress them with the importance of safety.

The learners are immediately assigned to lathe, grinder, or milling machine operation. The type of machine on which they start is the one which they remain throughout the course. Motion pictures from the U.S. Office of Education are used to supplement the teaching given at the machine, and are shown to the learners during the first week in the course. Also, each learner is provided with an instruction booklet, which explains the use of scales, micrometers, and verniers; reviews subtraction and addition of fractions; and covers fundamentals of blueprint reading.

Instructors grade the students A, B, or C at the completion of the course. The ratings are based upon the student's aptitude, ability, and interest. When the learners finish the course, they are placed in the shops on jobs ordinarily done by men, where they are paid at men's rates for their work.

## Accelerated Course Set Up to Provide Basic Training for Welders—*Bigelow-Sanford*

Bigelow-Sanford Carpet Company, Thompsonville, Conn., started a new business with five trained mechanics—a type of business entirely foreign to carpet making. It established a modern welding shop.

There was only one problem, according to E. I. Petersen, superintendent, —trained men to operate with. The department was started in June, 1942, when few idle hands were available. The type of product prohibited the use of women. The answer was to use men who were available, train them to be mechanics, but train them quickly.

The first step was to establish the type of instruction required. The State Board of Education was called in. The director of the State Trade School at Manchester assisted in laying out a program of action, and has continued to assist and advise. The program was broken down into four main headings: Cleaning training, burning training, fitting training, welding training.

Each man gets basic training in the use of simple hand and pneumatic tools—hammer, chisel, wire brush, descaling hammer, chipping hammer, files. This takes from three to four weeks.

Employees chosen to be developed into mechanics are then given an intensive course in the use of oxyacetylene cutting with a hand torch, then an introductory course in welding with general-purpose straight-polarity rod, continuous, intermittent, weave, butt, fillet, multi-pass fillet, lap, multi-pass lap, overhead, and vertical. Next comes basic training in fitting, which includes the assembly of all specimens required on the training program.

Naturally it is impossible to devote the entire day for training purposes. Direct instruction lasts on an average of three hours a day; five hours of supervised production work under the guidance of the instructor follow.

Young men have been employed with the full knowledge that their stay may be short because of Selective Service. It has been successfully demonstrated that carefully controlled training can increase the effectiveness of a new workman so fast that even after 25 to 35 per cent of his working day has been diverted to training, he accomplishes as much or more over any period in excess of 90 days. Whether these men go into the armed services or not, they represent a good investment and the company feels they are better qualified to serve their country when they leave.

## Operation Trainer Program—*Bullard*

Proceeding beyond the standard training courses, The Bullard Company, Bridgeport, has developed a special course to speed the training of new men under the problems peculiar to the machine tool company itself.

Termed the "operation trainer program," the course is divided into an elementary section requiring six hours of lectures, and an advanced course requiring ten hours.

The elementary course is divided

into eight sections. It opens with a discussion designed to show that training is needed to develop accuracy, skill, and safety. Successive lectures demonstrate the benefits of a program to an instructor, discuss the best methods of training, the best methods of learning, and the importance of teaching the new worker to form "good habits."

The last three sections of the elementary course involve a demonstration of teaching methods, the discussion of ways of preparing the worker for his job, and a breakdown of manufacturing operations.

The advanced course, consisting of five lectures, opens with a discussion of the trainer's duties concerning the teaching of safety, standards, morale, good housekeeping, and adjustment of minor grievances. The second lecture covers breaking in the new employee, and his fears for his safety, of his ultimate success, his boss, and his new environment. Succeeding lectures are devoted to safety problems, to speeds and feeds and spoilage, and a discussion of the "satisfied worker."

## Women Welders—*American Central*

A final week of work on actual production jobs, to minimize the abrupt change from classroom to factory conditions, is a feature of the school for women welders operated by the American Central Manufacturing Corporation. Connersville, Ind.

Thirty-two percent of welders in the plant are now women, carefully selected for training. Practically all the women who begin the course, finish it successfully, and all must qualify their work at government standards, set by the U. S. Army Air Corps, before employment.

Applicants must be between 18 and 30 years of age, 110 to 140 pounds in weight, and 4 feet 10 inches to 5 feet 6 inches in height. Physical examinations are unusually strict.

The company is adapting itself to the new problems presented by women workers, and considers girls well worth the training and attention they cost. After training, the girls furnish their own slack uniforms and fireproof helmets. The company furnishes goggles of the latest type, for which a small deposit is made by the welder.

An incentive plan based on the output of the entire welding department, men and women alike, works out satisfactorily. Extra pay amounting to as much as 25 percent of base rate can be earned by the group.

Because much of the company's work involves the use of stainless steel, girls are given extra training on this material, but practice in learning how to light, handle, and adjust a torch is confined to the less expensive mild steels.

## Women Machine Tool Operators—*Scovill*

To fill the gaps in the ranks of younger mechanics and apprentices created by the demands of the armed forces, and to satisfy the needs of increasing war production, the Scovill Manufacturing Company, Waterbury, Conn., organized a special training course for women machine tool operators in the spring of 1942.

Training is provided on phases of machine tool operation that can be mastered in a few months, and are not too arduous for women.

Lathes, shapers, milling machines, grinders, and other machine tools are set up in a special training department. Instructors are qualified journeyman mechanics. All the work is on a production basis, eliminating the scrap and other undesirable features of a "made work" program.

The training period covers about 1100 hours, divided into seven periods of four weeks each. The first four weeks are considered a probationary period. If possible, the trainee is exposed to work on several types of machine tools during the first period. The demands of war production, however, usually make it necessary to keep her on the machine to which she is first assigned, unless she indicates a definite lack of aptitude for that type of work.

Typical of the training is the experience in the lathe section, where the trainee is taught first how to read a micrometer and other measuring devices. She is then shown how to locate center holes, and to do simple operations on work which can be mounted readily between the lathe centers. This is followed by a period of work with chucks. Then she is shown how to mount and remove the chuck from the spindle, and is instructed in the use of the center indicator. Various methods of turning and boring tapers are explained, and instruction is provided in drilling, reaming, and tapping operations, and in cutting screw threads.

## Training in Precision Work—*Bausch & Lomb*

The manufacture of precision optics requires people who possess a high degree of technical skill. The problem at Bausch & Lomb, Rochester, according to Jackson Gallup, director of training, is to find people with potential ability and teach them what they need to know in order to work in a most precise industry.

It was decided that a broad program of training was needed, proceeding from elementary knowledge all the way to the skill required of an operator—and, beyond that, to the special skills of instructors, supervisors, and foremen. To meet the needs of the emergency, it was decided to simplify the jobs and develop any specialized skills.

An employee going into precision optics is assigned to a 3-day pre-department training course. The subject matter was selected by collecting and sifting the suggestions of foremen and superintendents, utilizing only the material that was agreed to be most essential. The 3-day period orients new employees in their work environment, provides them with valuable basic knowledge and skill, and gives the training department an opportunity to evaluate trainees with a view to placing them where they are best fitted.

After finishing the pre-department training, a new worker goes directly to his department where, with several other trainees, he is taken under the wing of a carefully trained job instructor and assisted by a "job coach," a helpful work manual. It is the responsibility of the instructor to see that his trainees learn to grind or polish, as the case may be, as rapidly as they can. When they have become capable operators, they are taken off the training machine and turned over to the floor supervisor. As operators, they continue to grow by doing various types of work until they gain a good general experience. Those who show unusual ability may be considered in line for supervisory jobs.

Optical inspectors are trained in essentially the same way, but assemblers go through a somewhat different process. They are sent to a training center located at the Rochester Athenaeum & Mechanics Institute to receive assembly training in the use of tools and machines. The course for this school was developed to the specifications of superintendents and foremen of the departments concerned. A Bausch & Lomb instrument maker is in charge of this program. This center serves as a reservoir of trained people from which departments requiring additional help may draw.

The training department works through committees appointed by superintendents. The committee members are close to the actual problems, and assist in the development of training materials—for example, the above-

**Supervisor on B-17 bomber assembly line at Vega shows high school boys how. Lockheed and Vega are employing hundreds of boys in a work and school program which lets them graduate with their class**

mentioned "job coaches." These manuals are fully illustrated and tell operators not only what should be done on a particular job, but also *how* and *why*. The guidance received from factory committees is of tremendous value in keeping the training department on the right track.

## "Four and Four" Plan for Boys—*Lockheed*

Last January the first "boypower" program in the west coast aircraft industry was launched at Lockheed Aircraft Corporation, Burbank, Calif. At that time about 400 boys, 16 and 17 years of age, became half-time aircraft builders in a "four and four" plan, under which each boy attends school for four weeks, then builds airplanes for four weeks, or attends school four hours a day and works four hours a day.

The Lockheed-Vega program differs from other plans in that the boy is hired only through his school. He must live at home. He must keep up his grades in school or drop out of the program. The written consent of the parents or guardian is necessary before he can enter the shop. The school boards of Pasadena, Burbank, Glendale, Los Angeles, and other nearby cities have cooperated in many ways, including the assigning of coordinators —faculty members who go right into the factory with the boys and there act as advisers.

The schools have also accelerated their classes and kept their teachers on the job in sufficient numbers to set up a 12-month program that takes no time out for the usual summer vacation. Thus every boy will graduate with his class just as he would if he were not working.

## Course in Chemical Equipment—*Merck*

Included in the program at Merck & Company, Rahway, N. J., are the kinds of training usually found in industry—from the orientation of new workers to the training of executives. The training department takes greatest pride, however, in its course in the construction and use of chemical equipment.

This course, reports Ernest Bartell, director of training, was first offered on a voluntary basis more than a year ago. Now it is a part of the training of all new women workers in the factory and pilot plant. Upon being hired, a woman worker is sent to the training department for the course; requisitions for helpers are filled from these trainees.

The purpose of this training is to acquaint workers with the fundamental principles involved in the equipment used in manufacturing chemicals, and also to familiarize them with the equipment itself.

Nothing is more bewildering than a chemical factory; it may be a pipefitter's dream, as someone has said, but it is also a nightmare to a novice. If, therefore, the eyes of a woman worker can be opened to what is going on around her, and if the company can help her feel at home in this maze of equipment—even before she gets on the job—it feels that it has accomplished a great deal in breaking in this new worker. The company is convinced, also, that it has laid a sound foundation on which she can build thoroughly and rapidly the skill needed for operating purposes. At least, she is not afraid of what she sees around here.

Material covered: (1) Instruments and measurements, (2) containers and services, (3) crystallization and dryers, (4) filters, (5) filter presses and sparklers, (6) centrifuges, (7) extractors, (8) stills, (9) pumps.

Each subject in the course is presented in five stages:

1. The principles involved
2. Study of the particular piece of equipment by means of charts, diagrams, and pictures
3. Laboratory demonstration of the operation of the equipment—in miniature (combining 1 and 2)
4. Observation of the equipment itself in actual operation
5. A written test

The time given to covering the material of this course varies with circumstances. If workers are urgently needed immediately, the training may be shortened; if it is known that a particular worker is headed for a definite type of work, she is given that part of the course that is of immediate value to her. The course does not pyramid itself into a large body of knowledge, but rather each section is a unit in itself. As a result, a trainee may enter training at almost any time and the course can be as long or as short as the company wishes to make it for any given set of circumstances.

# HOW TO MAKE THE MOST EFFECTIVE USE

# STEP 4 Apply That Will

THERE NEVER WAS A TIME when the administration of wages was more complex than it is today. It is estimated by the U. S. Department of Commerce that the nation will be called on in 1943 for a gross production of approximately $140,000,000,000 as contrasted with about $100,000,000,000 in the highest prewar year. Well over half of the manpower of the country will go into the war effort. Where 46,000,000 people were employed in 1940, the total in 1943, including the armed forces, is expected to reach 63,000,000.

Basically the total labor supply of a nation is a relatively inelastic quantity. The current demands for manpower have been met by the extensive employment of women, by increasing the working hours, and by combing out the relief rolls. The manufacture of many peacetime commodities has been forbidden. Late in 1942 and early in 1943 we actually experienced a short period of temporary unemployment as people shifted from proscribed peacetime industries to war jobs.

The normal trend of wages in such a situation is, of course, upward. In a market for any commodity, including services, the price of the commodity will settle at a point where the least anxious buyer would withdraw from the market if the price went up, and where the least anxious seller would drop out if the price went down. In such a market there are buyers who would be able to pay more if they needed to, and sellers who could afford to sell for less than the prevailing price. But, if the price were raised, someone else would stop buying, and other sellers anxious to dispose of their product, would bid the price down to about the former level, while the process would operate in reverse if the price were reduced. If, in such a market, the demand increases so that there are more buyers willing to pay a given price, while the number of sellers remains unchanged, the price will rise. This is what took place in the last war, when wages reached fantastic heights; it has already taken place to some extent in this one.

Extending this economic analysis a little further in order to review the essential elements in the present situation, we note that this tremendously expanding production is being paid for to a large extent with money borrowed against future tax income. Consequently the supply of money both in the banks and in current circulation has increased greatly. The goods for which this money can be spent, have been sharply reduced in quantity by the urgent competition of the materials of war. It follows inevitably that tremendous pressures are generated to reduce the buying power of money, and there is, in consequence, a world-wide and justifiable fear of inflation.

## Limiting Quantities

Can these forces be so brought under control as to avoid inflation and its peril of breakdown of the economic system? One way of control would be by the force of law to limit the quantity of goods manufactured. This has already been done by the War Production Board; we shall doubtless see more of it. Another way is to make money scarce; the simplest way to do this would be to take it away from people by taxation or to force the purchase of bonds. These measures are so contrary to political expediency and the philosophy this country has followed for the last

SE OF MANPOWER

# lyncentives

# ilGet Production

**The first essential of a good wage plan is an accurate measure of performance. When management and employees know exactly what is to be expected, the particular plan of payment becomes secondary**

decade that it is likely to take a more serious jolt than we have yet seen, or a greater resolution than our political leaders have yet shown, to apply them to an effective degree. Of course, in a battle as great as that against inflation, even partial control is a victory.

Still another method would be to draft manpower—to tell a man he must work at a particular job at whatever wage level is deemed expedient. This method has also been partially applied in this country, and much more widely abroad where the peril of the situation has been more urgently brought home to the public, and where, in the Axis countries at least, people have been more accustomed to comprehensive governmental controls.

Still another method is the price ceiling, and this is also being applied to wages at the present time. Of all methods it is the most difficult to enforce. It attempts to control the river at its mouth; control is easier at the source. The enforcement of wage ceilings without complete over-all assignment of the laborer to his job will act as a brake on price increases,

but can hardly prevent them. It is never possible to secure complete equality of all prices, and there is a constant ratchet-like action—a raising of wages at one point because of irregularities or an increase in living costs, and then raising prices and living costs because wages have gone up.

This is the situation in which today's employer must hire his help. A constantly increasing demand for workers continuously reduces the available supply. One way to secure more help, or to hold what one has, is to raise wages, but here one runs into a public policy which he, as a patriotic citizen, desires to support, and regulations he must follow.

The War Labor Board, assigned the task of maintaining wage ceilings, has recognized the dilemma of the employer to a certain extent. The "Little Steel Formula" recognized a 15 percent increase in living costs and provided a measure of elasticity in the adjustment of wages. Some additional freedom would be provided were the WLB to allow increases of wages where such increases did not increase the unit cost of the product. This would be an encouragement to more effective operation, which should benefit the national effort without endangering prices.

Many of the economic measures being applied, are new to our national experience although they have shown their effectiveness in current European applications. It is inevitable that the wage and labor policy of the government will change, and change rapidly in many cases, as we learn to apply the new controls. The first necessity of a successful wage policy for any firm would therefore seem to be to maintain a sufficient contact with regulations, through current publications and information services and direct contact with regional government representatives, and to adjust company policy and wage rates intelligently to this changing situation.

An enormous load has been thrown on the national boards and other federal agencies, and some serious delays have resulted. As this is written, a wave of strikes testifies in part to the impatience of employees who long have been kept waiting for answers because of this overload of the federal machinery. Discretion and support are, of course, required in federal contacts in order that this overload may not cause a breakdown which would be as disastrous to employers as to the war effort.

The pressure for raising wages has led to a thorough canvass by some employers for possible loopholes in the law, and specialists are already appearing with wage systems designed to handle the situation. Time study men are under pressure to ease allowed times. Bonuses are being paid in many cases, and extra non-monetary services such as free meals furnished. Beginners are being hired at rates normally given to experienced help, promotions speeded up, and new wage systems experimented with. While the individual employer is justified in applying the law to his best advantage, it is a safe rule to keep one's house in such order that an investigation need not be feared, and to get facts regarding ambiguous points before taking advantage of them.

## Wage Ceilings

The present national policy clearly looks toward holding down wages in order to avoid the terrible dangers of inflation. The employer who wishes to support this policy will ask himself how this may be done without depleting his forces or causing labor difficulties.

One clear answer is renewed attention to fundamentals of labor administration which have long been accepted. Wage demands are being made by people who feel that they are being underpaid compared with some other members of the organization. In a rising market, as today's, there is a constant temptation to unbalance the normal wage scale. You take on a new employee at wages equal to or even higher than those of old employees doing the same work. Wages are increased in one department with no corresponding change in another department. Formal job evaluation along recognized lines is definitely called for by this situation. Not only will it help to avoid trouble-making inconsistencies; it will also provide indispensable factual justification if the federal agencies question wage increases for particular jobs.

Of course, when the scale as a whole is too low, some way must be found to raise it if possible. In today's market we can, if necessary, replace the untrained beginners; it is most difficult to replace key men, and the range between routine and key jobs should be widened if necessary in order to provide insurance against the loss of key men. There should be a similar review of shop rates and of the basis on which standard times are set. Time study men as well as supervisors and personnel people should be kept informed of the essentials of the company's current current wage policy.

More than usual attention should be given in the present situation to the upgrading of old employees. This is always good organization policy and provides an essential incentive toward improvement by every member of the organization. In the present situation it may further afford an alternative to the excessively high rates often asked by men in the managerial and specialist brackets who are now shopping around, trying to take advantage of the abnormal market.

The times also clearly call for the utmost utilization of the "non-financial" incentives. If a secretary is getting $125 per month and knows that a competitor (who may be Uncle Sam himself) will pay her $180, the temptation is likely to prove pretty strong. Even at that she may weigh pleasant work, a good boss, and post-war security of job against today's big money. But with less spectacular differences, whether she goes or stays is likely to be determined quite as much by whether she likes her job as by the rate of pay.

## Check Personal Problems

Watch supervisors. Do they take time to listen to employees and talk to them now and then about personal problems? Watch the handling of the new employee. Does someone take the trouble to make him feel that he belongs? In these days of housing problems, has anyone checked up to see that the new employee is comfortably located? Do the single men and girls have any means of entertainment or social contact with other company people after hours? Or do they eat their hearts out, bored and lonely?

Are your employees carefully taught their jobs or are they left to find out for themselves? Do they know if they are making good on their jobs, or what is required in order to make good? Do your supervisors know how to direct people? Do they lay out jobs that are a fair challenge to a man's powers, but for which he has the training and the facilities? Or do they nag at people, on general principles? Is the atmosphere of the plant or office easy and free? Are such details as seating, temperature in workrooms, lighting, ventilation, clean lockers and washrooms, and places to eat systematically and sensibly taken care of? The list of such "non-financial" elements which affect a man's appetite for his work is, of course, endless, but there is no shop that has done all it should to utilize to the full that part of the employee's will-to-work, outside of direct financial considerations. In this day when every employee is wondering whether he ought not to look around to see whether he can better himself, and when the possibility of

## How Selected Plants Are Solving Wage Payment Problems

| | Number of Firms Using | Number of Employees Affected | Percent of Total Employees |
|---|---|---|---|
| Total | 31 | 139,558 | 100 |
| Day rate (or salary) | 27 | 65,842 | 50.7 |
| Piece rate – guaranteed | 6 | 37,026 | 28.6 |
| Piece rate – straight | 3 | 2,090 | 1.6 |
| 75% bonus (such as Bedeaux) | 2 | 89,938 | 6.9 |
| 50% bonus | 2 | 1,930 | 1.5 |
| 100% bonus | 5 | 1,067 | 0.8 |
| Measured day rate | 2 | 400 | 0.3 |
| Group payment plans | 3 | 708 | 0.5 |
| Profit sharing plans (annual) | 5 | 51,262 | 39.6 |
| Annual bonus, company discretion | 8 | 14,789 | 11.4 |
| Cost-of-living adjustment | 4 | 3,496 | 2.7 |
| Executive profit sharing bonus | 6 | 161 | 0.1 |
| Foremen's cost reduction bonus | 3 | 50 | |

**To obtain some idea of current wage-payment practice, a number of employers with forces ranging from 98 to 45,000 were questionnaired. Thirty-one took time out, in these busy days, to answer**

wage increases is so limited, it is doubly necessary to avoid those dissatisfactions and complaints that so often start the employee to thinking about a new job.

Two common mistakes must be avoided in work of this sort. One is the substitution of the indirect and generalized benefits of welfare plans, kind words, and the like for an adequate market wage. The other is the undertaking of such activities in the "father knows best" spirit. Too often employers have agreed to the desirability of personnel and welfare work, and have accepted steretotyped programs or applied personal hobbies, without finding out from the employees themselves the things that are important to them.

## Incentives That Hold Men to Their Jobs

On the whole, the trend of today's thinking seems to support an opinion expressed in 1936* to the effect that the interest in new and fancy wage plans was likely to decrease. It is being more and more recognized that the first essential of a good wage plan is an accurate measurement of performance. When management and employees know what is to be expected, the particular plan of payment becomes secondary. There has been altogether too much of a tendency to follow abstract and overrefined lines of analysis in developing wage systems.

Stop and think what are the incentives which hold you to your job. The total amount of pay is, of course, important. It is important both because you need the money and because it constitutes the most obvious measure you have of your place and recognition in the community. Your annual salary or wage is one of the ways in which you, your wife, and your neighbors rate you and determine the weight you carry in the community. It is of the greatest importance to you that you get as much as you are worth, and that you get as much as other people doing similar work. As to exactly how the wage is computed, provided the weekly or annual total is satisfactory, you and the workmen you employ are likely to be less interested in procedure and formula than in results.

If your job were a satisfactory one which permitted you to do things which you enjoy doing, or which, at least, challenged your interest and made you feel that you counted for something, you might even be willing to work for nothing in some conceivable community where the question of support was separated from the question of recognition and satisfaction. Not all jobs are interesting enough to meet this abstract test. Maybe yours is not; but clearly the money paid is only part of the things that cause you to perform your work.

Much routine work is relatively uninteresting. People work at these jobs because they need the money, although with a sufficiently good fit of people to jobs there need be only a few jobs which cannot be done either by a machine or by a person who finds his work interesting.

## Piece Rate Systems

For such jobs, a system such as piece rate increases interest. One of the things that makes a job stimulating is a measure of performance, a goal. Harrington Emerson once commented on the difference between a morning spent shopping with his wife and a morning on the golf links. The distances covered were probably about the same, but the fatigue generated was not. In the one case progress was measured and toward a definite and pleasant goal; in the other there was no goal, and no measure of progress.

Piece rate, or any similar payment for specified achievement, is psychologically sound. Most workers like it when they have confidence in the competence and fairness of those who determine the measure of the day's work. One test of the soundness of any wage system is that it allows the employee to measure his progress as he works and this measurement is effective in the degree that performance can be translated directly into dollars and cents earned. It is notable that, although still in use, the more involved systems, such as the Emerson or Rowan plans, are less and less met with in current practice. Theoretically, precision in the application of exactly the right amount of stimulus is of less importance than simplicity and over-all adequacy in the wage paid.

Simplicity also cuts payroll-keeping costs. Where large numbers of short jobs, not likely to be repeated, are done, the cost of setting standards may well exceed the possible value of a piece rate or measured performance plan in increasing output. Good supervision, trained to estimate with reasonable accuracy what constitutes a fair day's work and to observe which members of the organization are exceeding or failing to meet such a standard, may be preferable to any

* "Wage Incentives," a Plant Operation Library, FACTORY, March, 1936.

measured incentive plan. Promotion is a powerful incentive, if given only when earned. That day rate with adequate supervision secures results is indicated in the table on page 119.

To obtain some idea of current practice, a questionnaire was sent to a number of employers, with forces ranging from 98 to 45,000 employees. Thirty-one firms replied. The table herewith represents, with some minor approximations, substantially the practices of these firms. Doubtless other plans of payment were used, but were not reported.

Of the 31 firms replying, 27 use day rate or salary, some in connection with other systems and others as the only method of payment. Day rate continues to be a standby among the wage payment plans. The other plans divide themselves, not too exactly, into three general categories. There is, first, the straight piece rate, including such related forms as a straight commission for a salesman and plans in which more than one element of performance, as both quantity and quality, are considered in output and paid for on a weighted scale.

About 30 percent of those replying to the questionnaire state that they use piece rate; 28.6 percent of the total employees are under guaranteed piece rate, 1.6 percent under straight piece rate.

It is characteristic of good wage payment plans, except in the case of transient workers and high-paid executives who can afford to speculate, that there should not be too great a fluctuation between earnings of the highest and lowest paid periods. During a period when earnings are low, the employee is cramped by his normal expenses and commitments. He worries and is likely to wonder whether he cannot get a better job. Extra earnings on the other hand, are likely to be dissipated without much advantage to the average employee. The trend toward minimum guaranteed payments is clearly sound from this standpoint.

## Bonus Plans

A second plan for the payment of incentives, which has many forms, is the basing of the payment on actual as compared with expected or standard performance. The Halsey plan is, with its variations, one of the commonest and most useful examples. Under this system a standard time is set for the performance. If the job is done in less, the worker is paid some part of the time saved. The survey mentioned above indicates that about 7 percent of the employees included are paid a bonus of 75 percent of savings about 1.5 percent are paid a 50 percent bonus; and not quite 1 percent, a 100 percent bonus.

Under any one of the bonus plans in practice, the allowed time is entered on the worker's time card, and the time actually consumed also is recorded. The employee is charged with the time worked in the period and credited with the total time allowed on the various jobs. If, in a 40-hour week, he were thus credited with 48 hours of allowed time, and if his rate of pay were 60 cents per hour, he would earn, in addition to his day pay of $24 per week, a bonus of $4.80 under the 100 percent plan, $3.60 under the 75 percent plan, and $2.40 under the 50 percent plan.

The 75 percent bonus was adopted in connection with a bonus for foremen and a system of accounting for productive time; it is used by a number of large companies.

Workmen often object to any plan that fails to pay full prices for increases in performance. The working man cannot see why he should share his earnings with the employer, if the rates are correctly set up. Because of this rather common objection on the part of labor to the 50 percent and other percentage plans, the tendency has been with Bedeaux, and with other systems, toward the 100 percent basis of payment. At 100 percent the system becomes indistinguishable from the piece rate except for a few details. The man's earnings and bonus are determined by his hourly rate. This may have an advantage, in the recognition of older employees who are paid a higher rate because of the length of service, but will cause difficulty if there are wide variations in day rates of men doing the same job.

## Profit Sharing Plans

A third class of payment plans, including a number that may be used in combinations with those previously named, are the profit sharing plans. They are a number of types. In one case, apparently increasingly popular and useful at the moment, the company sets aside some announced share of its annual profits, usually after insuring a certain fixed return to stockholders, to be shared on some basis between stockholders and employees, as a bonus, usually annual, paid so as to distribute the total of the employees' share in proportion to total earnings or hourly rates.

There is a growing use of bonus plans for supervisors. These bonuses are often called profit sharing, but are in reality based on the percentage of the savings made in actual costs of operating the department as compared with the budget allowance. Such bonuses, used in a variety of applications, are of the same nature as the piece rate or Halsey plans.

Still another type of bonus in rather common use is an annual gift, determined at the company's discretion.

Annual bonuses do not meet the requirement of being directly and immediately related to performance. They have value in giving the employee a stake in the company. He is likely to think twice before quitting his job. The bonus probably has a greater value in making the employee feel that the company thinks of him as a partner. It is also possible through an annual bonus to increase the employees' compensation in good years without committing the company to an excessive burden in less prosperous ones.

In this third group of plans might be included a number of miscellaneous plans. There is little interest for the moment in annual wage, year-round employment plans, such as those used by Nunn-Bush, Hormel, Sears-Roebuck, and some other companies. Interest in these plans is likely to revive in the post-war period.

## Some Post-War Wage Payment Possibilities

Some companies have inaugurated plans for assisting employees to build up reserves to meet post-war uncertainties. Where such payments are deductible from income tax and may be included as costs in government contracts, obviously the reserve may be built up without a comparable cost to the company. There is a question as to whether, except for this tax viewpoint, it would not be better for the company to strengthen its own financial position and liquidity, so that it can furnish additional security of employment after the war, rather than to pay the money in small amounts to employees with the attendant danger of dissipation and inadequacy.

For any job for which a standard of performance can be set for an individual it should be possible to set a corresponding standard for a group. Group payment plans aroused great interest a number of years ago and were probably overdone in some cases. Where a group is small enough for self-supervision, homogeneous, preferably serialized so that each person has his own unshirkable part in the work, group payment plans reduce bookkeeping, encourage teamwork, and have proved most successful.

At present, the important plans

seem to be the day rate, the Bedeaux type, the 100 percent bonus plan, group plans, and the various types of annual bonus payments. We are likely to see more plans adjusting wages to increases in cost of living. While attendance bonuses have been advocated, they are apparently not in widespread use, and they rest on the rather questionable idea of paying the employee a bonus for something which he has already undertaken to do for his regular wage. There will be very few situations in the payment of shop or factory workers, salesmen, executives, or other people to which one of the plans named will not prove adaptable.

Some day our two-front war will subside to one. Eventually peace will come and the boys will be returning to their old jobs. Only companies whose performance standards have been long tested and accepted, are likely to escape serious distortion in their time standards and methods as a result of wartime changes. All the circumstances, both of present-day emergencies and of the inevitable post-war adjustments, seem to indicate the possibility of continuing with present plans of payment, making changes only where necessary to correct serious difficulties, rather than to experiment without good reason with plans which must of necessity rest on insecure standards of performance. It would seem better, in most cases, to get along as best one may with an existing system for the duration, taking pains to see that earnings are consistent internally and in line with local markets externally, and to postpone any major overhaul of systems until after the war.

## Piecework Plan, Prizes, Profit Sharing, and Bonuses— *National Cash Register*

The National Cash Register Company, Dayton, employs several types of incentives in the factory. Individual piecework incentive pay has been in effect for more than 50 years, and a group piecework incentive plan for more than 25 years. The individual pay plan is used wherever possible. The group incentive pay plan is used on group jobs, where a 1 percent bonus is paid for each percent above 100 percent efficiency as determined by time studies. Seldom are there more than 25 employees in any one group, so that every member can be familiar with any unusual conditions which may arise in the operations.

Efficiency rates—and therefore incentive rates—are set as a result of stopwatch studies conducted over a period of many years. More than 250 jobs or operations have been classified, and are represented by standards which establish rates for these jobs. With new operations there are usually a number of elements, as indicated by the blueprints or by previous time studies, which can be determined without new stopwatch tests. The use of these standards provides a fair and equitable basis for setting incentive rates; at the same time, they reduce the need for original time studies.

Another type of incentive utilized by NCR is prizes for suggestions. This practice was started by the company in 1894. With a normal employment of about 7000, each year approximately 3000 suggestions are received. Some 25 percent are adopted. The rewards have been both merchandise and cash, the amount depending upon the value of the suggestion.

Each suggestion is studied carefully by the head of the division affected and by the suggestion department, and every effort is made to see that all division heads are wholly sympathetic to the plan. All suggestions are answered. If they are not adopted, reasons are given in detail, so that the suggester will be encouraged to submit additional ideas.

For those not eligible for piecework incentive pay, a profit sharing plan is in effect. The company has given a bonus at Christmas for many years.

All these incentives are felt to be overshadowed by another, which is not normally so classified. That is the use of photographs and personal references in the employees' house organ. It has been repeatedly demonstrated that employees respond handsomely to pictures of themselves and their families. In fact, it is the general observation that this type of satisfaction appears greater than can be achieved in any other way. This is particularly true of a company which has, since its founding, drawn a major portion of its employees from among the families and friends of former or present workers.

## Foreman's Bonus Plan— *Consolidated Aircraft*

In the foreman's cost conversion bonus system, operated by the Consolidated Aircraft Corporation, San Diego, Calif., percentage bonuses are calculated for each department, and are applied to the salaries of participating factory managers, superintendents, foremen, and assistants. While part of the bonus is paid for the individual performance of a department, an average of performance in all productive departments is taken also, to determine the plant's average. This total is applied equally to all sharing departments to encourage interdepartmental cooperation. Such cooperation is essential, because the failure of any one department results in starvation of assembly lines, with resultant slowing of production.

## Annual Bonus for All— *Lincoln Electric*

One of the motivating factors of the incentive plan at Lincoln Electric Company, Cleveland, is the advisory board, established in 1914. This "board of directors for the plant" handles "all matters affecting the men and shop operations." It is composed of one representative from each department, elected by all members of that department, a foremen's representative, the plant superintendent, and the president.

Among other things, this board has decreased work hours from 55 to 50; established a paid-vacation plan (1923); installed a suggestion system (cash for one-half of the first year's savings); arranged for free life insurance (one year's wages) and a trust and retirement fund; established a piecework system plus a bonus plan that is normally equivalent to a year's wages.

All productive work is paid on straight piecework rates, with the rates determined by job evaluation. Added to the basic wage, and paid at the same time (twice monthly) is a percentage based on a cost-of-living index selected by the advisory board and used since 1936. If the cost of living, as figured by the U. S. Department of Labor, goes up or down 5 percent, the percentage added to the basic wage fluctuates by the same amount.

Overtime is paid at time and a half. At the request of the employees, all the half-time wages for the hours over 40 worked in a week are retained and paid out at the end of the year with the incentive pay. If an employee is discharged or resigns, he receives his accumulation on leaving.

The incentive pay—paid in December each year—is paid in a lump sum, included with the accumulated overtime pay. The amount of money available for distribution depends upon how successful the productive efforts of all have been. Every employee on the payroll before October 30, and still on the payroll on the date of pay-

ment, shares in the bonus, except the president and the chairman of the board. Amount of share depends upon earnings and length of service.

Another accomplishment of the advisory board is making possible the purchase of company stock. Any employee with one year's service is eligible, and more than half the workers take advantage of the opportunity.

The company reports excellent results from the activities of the board, such as employee earnings approximately double those for comparable operations elsewhere, output per employee 300 to 600 percent that in comparable industry, reduced selling price of typical products by 13/15 and more, labor turnover reduced to practically zero, no labor union.

## Post-War Trust Fund—*United Electronics*

A trust fund plan under which 250 employees will share profits of the war period at the end of the war is in force at United Electronics Company, Newark.

The plan is designed to stop turnover of personnel during the war, and to provide a nest egg for employees during the post-war period. The trust fund set aside the equivalent of 9 percent of the total sum paid employees in 1942. This plan will be followed for the remaining war years. The percentage set aside will vary in proportion to profits. Under internal revenue law it cannot exceed 15 percent.

To be eligible to share, an employee must remain with the company until the end of the war, unless he is called into military service. The amount due each employee will vary in proportion to his salary.

The plan is to pay out the sum in the trust fund over a period of years, but the employee will be paid in a lump sum if he quits after the war, or if, in the opinion of the trust fund committee, circumstances warrant it. Illness or discharge would be causes.

In no case can any part of the fund revert to the company. If an employee quits and forfeits his share, it will be divided among those remaining. Each employee is given a record of his stake in the fund.

Bonuses also are paid employees, and they get vacation pay, both of which practices will be continued under the trust plan. The trust fund will be invested in government bonds. It is administered by a committee consisting of the company treasurer, personnel director, and a representative of the employees.

## Piecework and Bonus—*Ohio Crankshaft*

Two types of incentives are used in the shops of Ohio Crankshaft Company, Cleveland. In the aviation division a standard time system is in effect; in all other sections regular piecework incentives are used.

The piecework system has long been established on a money value basis. It provides an hourly base rate guarantee as a buffer against conditions beyond a worker's control. The plan is set up on a basis of 25 percent above hourly base rates, and experience has shown a general tendency for employees to earn over this.

The standard time system was adopted by the aviation division when this new phase of Ohio Crankshaft operations was launched two years ago. It provides greater flexibility for the type of work done. By beating a standard time, a man qualifies for a certain bonus.

The system features a base rate arrived at by job evaluation that is gaged according to skill, experience, and effort required, and conditions surrounding the job. Experience has shown that a normal worker, if unlimited on his job, can on a daily basis easily earn a bonus of 25 to 35 percent.

With the Ohio Crankshaft time system, a definite unit of measure—the minute—is used.

In applying the standard time system, the units are grouped into hours or "indexes" which reveal how much an operator is turning out in an hour. A certain worker might have an index of 80, meaning that he is producing 80 minutes of work per hour, or 33⅓ percent more work than normal. "Indexes" are calculated on a minimum of one day's performance for all hours on standard time.

## Merit Awards Plans—*Three Canadian Plants*

A bonus plan for its 900 employees, of whom 60 percent are women, has been in operation by Canadian Aircraft Instruments & Accessories Limited, Toronto, for about a year.

Under the bonus plan, every employee is eligible as soon as he or she starts working. If the employee stays longer than four months, a bonus of 10 percent of wages begins to accumulate. At the end of the year, half of the bonus is paid. At the end of the second year, the remaining half of the first year's bonus and half of the second year's bonus are paid, and so on every following year.

Should an employee be laid off, the bonus is paid. Or if a man or woman enlists in the armed services, the bonus is paid on proof of enlistment. If an employee resigns, the bonus is sacrificed. Money put aside as bonus payments for employees who have left the company on their own accord, except for enlistment, is accumulated into a welfare fund available on decision of the management, and distributed through a plant committee to employees in need of money for unexpected expenditures.

Boeing Aircraft of Canada, Vancouver, has a long-service award plan. Having in mind a long-range view of the Canadian aircraft industry, the company issues 5- and 10-year enameled gold stars to employees who have been there that long. To date 28 men and women have received the 5-year stars, and three the 10-year emblem.

RCA Victor Company, Ltd., Montreal, has had in operation for some time, as part of its production boosting program, a Merit Award Plan. This plan is based on the principle that, as Canadian soldiers, sailors, and airmen on active service receive awards for distinguished service, so too should workers on the production front be recognized for distinguished service in war work. A rating card was drawn up by the plant superintendent, in cooperation with section foremen, with points to be awarded for each of ten items. Seventy-five points out of a possible 100 entitle the worker to an award of a colorful certificate, couched in terms similar to those used in military citations, and an elaborate award pin. Merit Award winners have stars added to their award pins for each additional month in which they have able to score a minimum of 75 points. Outstanding personalities are brought to the plant to make the awards.

The ten items on the rating card cover 100 percent attendance on the job; good health—points being lost for absence due to illness; safety—with workers being disqualified for accidents involving a day or more of lost time. Staying on the job and making every minute count are worth a maximum of 25 points; cooperation with everyone up and down the line counts 20 points; studying the job and asking questions if in doubt, account for 10 points; handling materials carefully and avoiding waste mean 25 points; keeping his spot in the factory clean and orderly is good for 10 points; suggesting ideas to increase production and to get the maximum use out of materials, tools, or machinery, adds another possible 10 points, with 3 points for each dollar awarded by the plant's suggestion committee.

**Lens inspector at Shuron Optical Company is on group bonus, which looks like this concern's answer to the current wage problem**

## Group Incentive Plan—*Shuron Optical*

The Shuron Optical Company of Geneva, N. Y., solved the current wage problem by installing a group incentive plan—the first to receive the approval of the New York Regional War Labor Board. In making the move Shuron secured the services of a firm of industrial engineering consultants and enlisted the wholehearted participation of Optical Workers Union No. 20890 (AFL), which represents the employees. Without the help of both, the whole thing might have "died on the vine."

Before too much work was done it became evident that there was no possibility of paying each individual according to his own performance. Because of the nature of the work involved in grinding and polishing lenses, it is impossible to determine quality until several weeks after processing. By that time the fixing of responsibility for poor quality to individuals was out of the question. This fact led to the decision to build a group rather than an individual bonus plan.

This decision had other favorable results. Absenteeism within a group affected performance adversely, so the drive for regular attendance was automatically transferred from foreman to group members. Workers with a tendency to show no interest in their neighbors' jobs saw overnight how much improvement could be made in group performance by becoming familiar with more than one job. Since all time unnecessarily spent in a group pulled down the group performance, requests began to come in to reduce the size of overmanned crews. This, in a day when additional help is at a premium, was ideal because finding a place to put the "extra" worker, thus removed, was no problem.

The fact that quality cannot be determined until all the work has been performed made it necessary to incorporate a quality factor into the incentive plan. Bear in mind that only perfect lenses are salable. Even the scrap value is negligible—about the same as broken bottle glass. This means that a 5 percent increase in quality factor results in a similar increase in salable lenses produced. For this reason the incentive plan as set up could logically pay some premium for increased quality with no increase in actual units of work.

After five weeks of operation, this much is known:

1. Weekly premium paid has varied from 3.5 to 21.0 percent by groups.

2. The departmental average premium paid has risen to 10 percent above previous base pay.

3. The increased payroll due to payment of premium has not increased the cost of the lenses. In fact, it has not even increased the labor cost of the lenses.

## Bonus for Promptness—*Electronic Labs*

Promptness in reporting to work is earning cash bonuses for employees of Electronic Laboratories, Inc., Indianapolis. Every worker who completes a month without being absent or tardy receives an extra $10 on his pay check. If he maintains that clean record for 6 months, he gets a bonus of $25 in addition. And if he is not tardy or absent for 12 consecutive months, he is awarded $50 in addition to the 6-months' bonus and the monthly dividend. Thus it is possible for a worker to earn an extra $195 a year just for reporting to work on time and failing to miss a day.

The bonus plan has one simple rule: "Don't be tardy or absent for any reason." There are no excuses. The time clock is the only judge of whether or not the individual shall receive the extra cash. The worker is paid off according to what is stamped on his card. If he is even a minute late, regardless of weather or extenuating circumstances, he loses the bonus, and there is no appeal.

The first month of the plan netted employees $5000; half the payroll of 1000 collected.

## Bonus for Attendance—*Bullard*

Perfect attendance pays well at the Bullard Company, Bridgeport.

A plan in effect since June, 1942, at this company's machine tool plant, gives every employee an extra 10 percent of his pay toward a war bond if he has been present and on time every day of each weekly payroll period.

In addition, those who receive the 10 percent premium have their names entered in a weekly drawing for war bonds. The drawing distributes a $200 bond as top prize, then $150, $100, $75, $50, and fifteen $25 bonds for the runners-up.

The drawing is conducted every Friday, either during the day or night shift, and is handled entirely by employees. Vouchers with the employees' names are drawn from a large simulated bomb.

# HOW TO MAKE THE MOST EFFECTIVE

# STEP 5 Benefi… Labor…

**Departmental displays of scrap rate high among the many valuable activities of the labor-management committee at Caterpillar Tractor Company. Set up in strategic shop spots, these displays are part of a successful drive to conserve materials and tools, can always be counted on to draw a crowd**

CTIVE OF MANPOWER

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# Cooperation

THERE IS NOTHING REALLY NEW about the thing called "labor-management cooperation." But the phrase as it is used under today's war conditions implies an unusually high degree of teamwork induced by some formalized means.

The historic case of the Baltimore & Ohio Railroad provides one of the earliest examples. At the conclusion of a period of strikes and dissensions, the railroad's management and union agreed to combine forces in a drive to reduce costs, eliminate waste, and improve efficiency—hoping thereby to forestall a proposed reduction in wages. Great success attended the plan. Grievances were reduced 50 percent, accidents cut to a minimum, and 3800 suggestions accepted within eight months.

Picked up and copied by other railroads, the cooperative principle was adapted and tested in other industries. Unions, such as the International Printing Pressmen, the Amalgamated Clothing Workers, the International Photo-Engravers, and the International Ladies Garment Workers, promoted efficiency practices and assisted employers in introducing improved methods as a means to higher living standards for their members.

"Works councils" and "committee" plans were occasionally introduced in individual plants as a stimulus to the cooperative idea. Employees participated at meetings with management at which efficiency practices were considered, and awards for cost-cutting and waste-saving suggestions were offered.

Withal, the cooperative principle, except as exemplified in the application of suggestion systems, was a fairly rare thing in peacetime. It had vigorous advocates, both among management men and labor leaders, but it spread slowly and at times seemed to languish altogether.

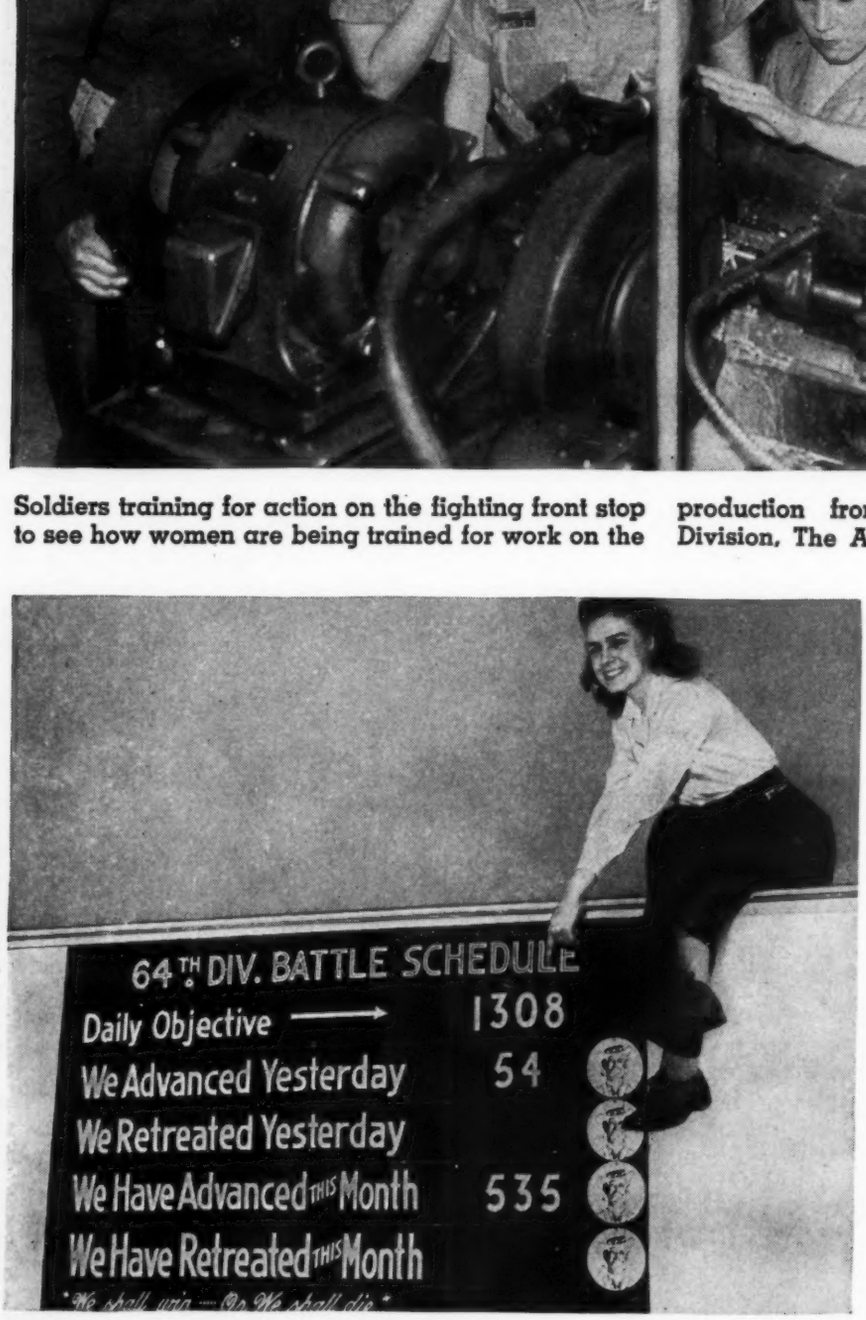
Then came the war. Management and labor found themselves with a new common objective, the defeat of the Axis. Production—and more production—was industry's only goal. This created an atmosphere highly favorable to a sweeping rebirth of the cooperative principle.

Certain companies, such as RCA-Victor and Standard Register, made significant strides with campaigns designed to stimulate defense production even before Pearl Harbor. And in March, 1942, Donald M. Nelson of WPB recognized the potentialities of the idea under war conditions and inaugurated a National War Production Drive.

The key factors of successful peacetime cooperation plans remained paramount—namely, suggestion systems, and councils or committees in which labor and management representatives participated. To these elements was added a third—the patriotic appeal through posters, publications, advertisements, sound systems, rallies, and other promotional methods associated with the improvement of "morale."

Within six months, WPB's War Production Drive Headquarters was able to announce that 2200 industrial companies had reported the formation of labor-management committees sponsoring war production drives. In October, 1942, FACTORY conducted a survey which showed that 80 percent of these committees were functioning actively, and that 84 percent of the managements were satisfied that these drives had helped to improve pro-

**Soldiers training for action on the fighting front stop to see how women are being trained for work on the production front—at Republic Aircraft Products Division, The Aviation Corporation, Detroit**




**Every department at Westinghouse, Lima, Ohio, has a war production scoreboard. Uncle Sam's face marks a gain, Hitler's a loss**

duction, efficiency, and labor relations within the plant.

What are the principal elements of successful production drives? They fall into two groups as revealed by an analysis of the many excellent company case histories of wartime labor-management cooperation programs described by FACTORY in the series entitled "How to Build the Will to Win," and in other articles:

## Committee Activities

1. Plantwide and departmental drives to beat production quotas
2. Suggestion systems
3. Scrap and salvage drives
4. Car-pooling and other transportation plans
5. Safety and health campaigns
6. Programs to cut absenteeism
7. War bond drives
8. Better nutrition campaigns
9. Blood bank promotion
10. Victory garden promotion
11. Support of Red Cross, USO, community chest drives

## Labor-Management Tools

1. Awards (war bonds, cash, vacation trips, emblems, pins, certificates)
2. Production scoreboards
3. Plant publications
4. Posters and banners
5. Pledge cards and pins
6. Slogans and songs
7. Displays and information booths
8. Sound systems
9. Rallies, parades, Army-Navy "E" ceremonies, speeches by war heroes, displays of fighting equipment.

One, some, or all of the activities may characterize a production drive. The objectives may vary with the problems of the individual plants. One, some, or all of the tools may be used to advance the activities. It is usual, where a plant has a central labor-management production committee, to appoint subcommittees applying to the several activities with an additional subcommittee to direct the handling and application of the tools.

What are the fundamental principles? Experience has disclosed that:

1. Any endeavor (whether it combines a few or all of the available activities and tools) to elicit the best thinking and effort of the entire personnel may be classed as a labor-management cooperation program and will probably produce gratifying results.

2. Although the active cooperation of labor in such a program is absolutely essential, management must assume the role of leadership if the plan is to succeed, since many of the major decisions affecting its success are management decisions.

3. Credit for success must be shared by management and labor.

4. It is essential that employees be given a full sense of participation in the war effort, especially if their connection with it seems remote, in order to awaken their enthusiasm.

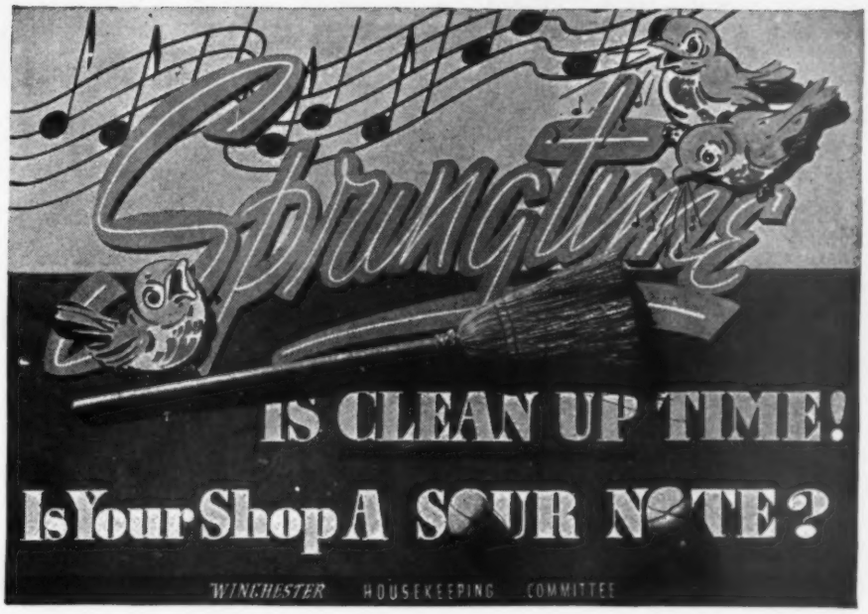
5. If a labor-management committee is utilized, it is desirable that the labor representatives be democratically chosen by the employees themselves.

6. No committee or program should get involved in questions of grievances, wages, or collective bargaining.

7. Labor must not seize upon such programs as a means of invading the field of management, nor must management attempt through them to curtail the rights of labor.

8. It is unwise to undertake a war production drive unless an adequate supply of materials, manpower, and orders seems assured.

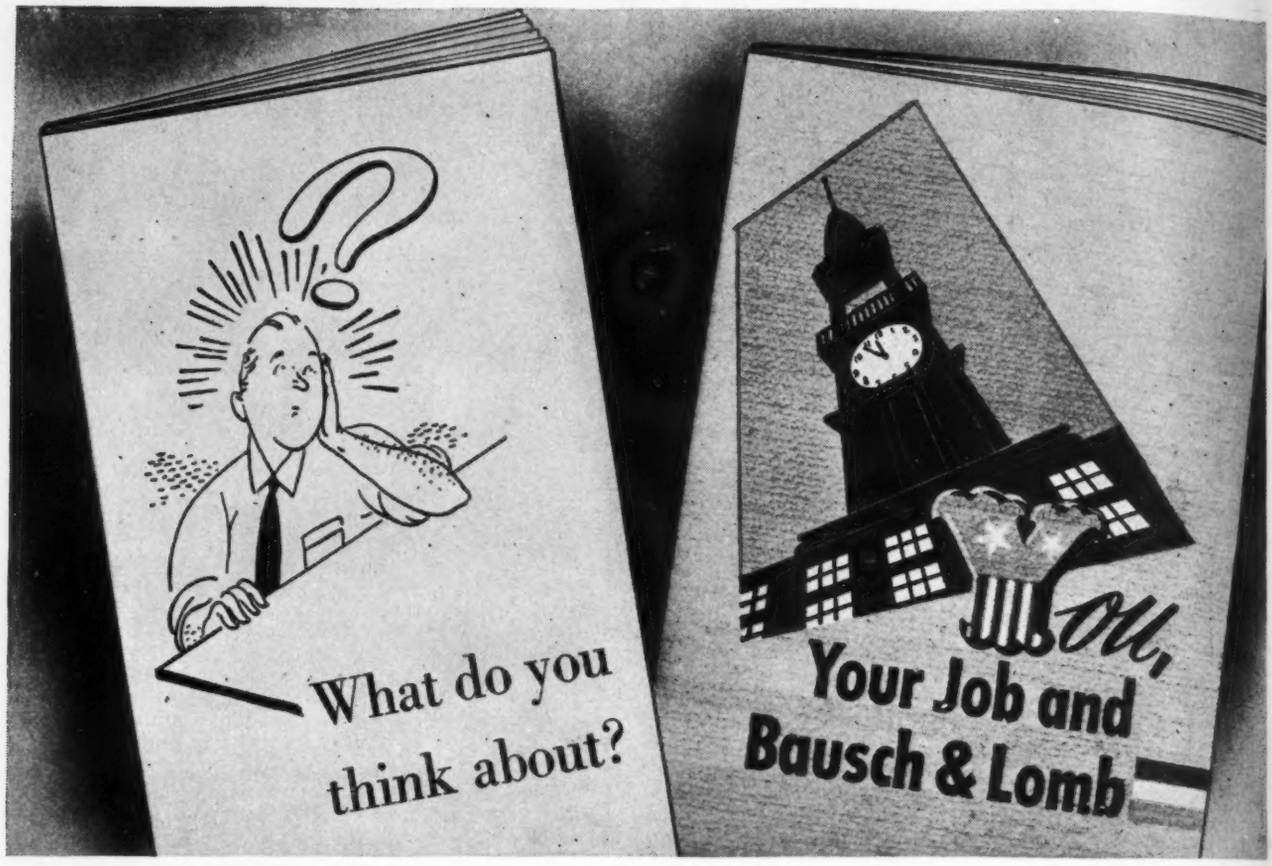
An additional element, hard to classify as activity, tool, or principle,




**Influence of women is seen at Winchester Repeating Arms Company, New Haven, where spring cleaning is pointed up with posters**

SINCE MILLER 1844
Miller Employees In The Armed Forces
Miller Employees In The Armed Forces
PROMISE FOR VICTORY!
DON'T LET THEM DOWN
STRIVE TO HELP THEM

**"Miller Elf" greets early birds with music, late comers with jeers. Case study on page 133**




**Booklets—one designed expressly to stimulate the flow of worker suggestions, the other an employee manual—are rated by Bausch & Lomb as just about its best tools of labor-management cooperation**

has come to the fore with the progress of the war on the fighting front. Stated, as it should be, in the imperative, it is this:

**Strengthen every tie between the employee on duty in the armed services, the employee in the plant, and the management.**

Industry is showing increasing recognition of the importance of this policy to sustain morale on the fighting and home fronts, and to assure a harmonious post-war adjustment.

Exceptional emphasis has also been laid on one activity which, earlier in the war, was ranked among the lesser objectives. That is the cooperative attack on "absenteeism." Its increasing importance as a production problem has made it the focal point, for a time at least, of a number of programs, although normally the reduction of absenteeism would not be considered among the major objectives of a labor-management committees.

## The WIPS, a "Military" Organization for Recognition of Women War Workers—*Du Pont*

An experiment in feminine psychology is going forward at the Spruance plant, rayon division, of E. I. du Pont de Nemours & Company, at Richmond. The plant has a high percentage of women employees. Hence the WIPS, which stands for *Women in Production Service*. A WIP knows she's in the war effort as much as any WAC or WAVE. So do others when they see the attractive insigne worn on the left sleeve of her uniform. Her rank—and she really has to earn it—may be ascertained by the bar (of the same size and shape as those of Army lieutenants) which she wears on her lapels.

All women in the plant begin as WIPS, First Class. They wear the fabric insigne and a plain plastic pin. On the basis of performance alone, the individual can work her way up through WIP, Senior Grade (red bar), to Major (gold bar). The achievements which mark her progress through Junior Lieutenant, Senior Lieutenant, and Captain, to Major, may be imagined by contrasting the qualifications of WIP, Senior Grade, with those of WIP Major.

A WIP, Senior Grade, has earned her red bar by: (1) War bond drive participation; (2) safety—no injuries for 30 days; (3) attendance—no absences for 30 days; (4) remembering her gate pass and punching the time clock regularly for 30 days.

A Major has earned her gold bar through the following distinctions: (1) Investing 10 percent of her pay in war bonds; (2) avoiding injuries for one year; (3) avoiding absences for one year; (4) submitting three suggestions, one of which has been adopted; (5) engaging in civilian defense activities; (6) earning a supervisor's okay for "efficient job effort."

The WIPS went into action on March 1. Their group achievements, as reported by Lewis A. Nuckols, of the Spruance War Production Committee, are impressive:

1. Absentee rates dropped from 6.2 percent in January to 3.8 percent in April, despite a longer work week and more short-service employees in the latter month.

2. In the WIP's first two months, 200 more suggestions came in than were submitted during all of 1942—and of much higher quality—with 40 percent adopted.

**"Suggestion Champion" of Goodyear Tire & Rubber Company, Norman K. Stump submitted 23 suggestions last year; 21 were accepted**

3. Injuries were reduced 61 percent (one plant unit employing 400 women went through March without a single injury).

4. The plant qualified for a Treasury "T" for war bond purchases.

"Different kinds of war jobs require different kinds of courage and determination," the WIP Handbook says. "To be on the job every day; to perform the duties of the job in a safe manner; to develop an alertness for possible job improvement; to put 10 percent of earnings into war bonds—all require a certain type of determination and sense of responsibility. For those women who have this sense of responsibility and are, therefore, giving their best as a 'home front soldier,' the emblems and bars of the WIPS will attest this meritorious service."

## "Wings" for Accepted Suggestions—*Packard*

A booklet, "Winning the Battle for Production," tells the story of Packard Motor Company's multiple "Work to Win" campaign. The Packard "WINGS" emblem is the award for an accepted suggestion.

In view of the general emphasis on cash prizes, war bonds, and so forth, Packard's apparently justified assumption of John Jones's perfect willingness to give his idea to the company for the sake of better production is an interesting departure. One important string is attached, however, for Jones's protection elsewhere. Part of the suggestion form consists of a statement which he signs: "My suggestion, numbered as above, I give to Packard Motor Car Company, but to Packard only, and, if there is anything patentable about it, I retain the sole right to patent it and grant licenses to others."

Another prominent feature of the Packard campaign consists of schematic "leading questions" which are used to channel employee thinking in definite directions. A new "leading question" is introduced in the announcement of each week or 10-day period of each campaign, such as:

1. Can you suggest a better method of doing your own job?

2. What do you recommend to be done to reduce scrap?

3. How can we get material moved through the plant in less time and with less handling?

4. What can you suggest to improve safety in the plant and to prevent accidents to employees?

5. The cleanliness and orderliness of the plant must be improved. What definite and specific suggestions can you make?

Under each of the leading questions the announcement carries subordinate questions designed to provoke specific thinking on the subject. Following Question No. 1, for instance, were these sub-questions:

1. How can you save time or save steps?

2. How can you simplify your work?

3. How can you eliminate things that delay or interfere?

4. How can your stock or finished parts be better handled or put in a more convenient place?

## Bonds and Stamps for Ideas—*General Motors*

In the first year of its operation, concluding in May, the General Motors Corporation's Suggestion Plan to Increase War Production produced 86,922 suggestions, of which 13,997 were accepted with payment to GM employees of war bond and stamp awards totaling $550,000.

"Particularly worthy of note is the fact that 61 percent of the total amount of bonds and stamps awarded has been paid for suggestions that improve production on the worker's own job—in other words, for suggestions that help the individual produce more for victory," said C. E. Wilson, GM president.

## Suggestion Plan in War Tempo—*Goodyear*

In many a plant, long-established suggestion systems have been stepped up to war tempo with gratifying results. The Goodyear Tire & Rubber Company, for example, has operated a suggestion program since 1912, has paid more than $250,000 for ideas, and has, since 1934, adopted an average of 24 percent of the suggestions submitted. The maximum award is $500. Suggestions are classified as follows: Safety, convenience in working conditions, quality, and savings.

Winners are widely publicized in employee publications. Groups of win-

**Stencils on floors at main traffic arteries and on paved surfaces of parking lots remind workers to "Back Up Our Battleskies" at Curtiss-Wright Airplane Division plants. All part of an intensive war production drive that extends to subcontractors and vendors**

ners are honored in plantwide ceremonies. Individual Production Merit emblems supplement the cash awards. James A. Merrill, research chemist, has been personally cited by President Roosevelt for his improvement of self-sealing aircraft fuel tanks. Dean of Goodyear's suggestion plan is George Boring, a zone engineer, who has had 9 suggestions accepted for a total of $800 in prizes over a period of 22 years. But the acknowledged "suggestion champ" is Norman K. Stump who, under war's impetus, submitted 23 suggestions—no less than 21 of which were accepted in 1942.

## War Bonds and Trip to Launching as Prizes in Suggestion Contest—*RCA-Victor*

The slogan, "Don't miss the boat," was used to head up a new suggestion campaign sponsored by RCA-Victor. The prize was a trip to Mobile for the top winner from each RCA plant. At Mobile, as a signal mark of honor, the RCA employees appeared as sponsors in the launching of a new Victory ship in the Alabama Dry Dock & Shipbuilding Company's yards. The trip was in addition to the regular awards in cash or war bonds, running as high as $300.

The tie-up between RCA production and the Victory fleet not only provided an extra-attractive suggestion prize, but also helped bring home to RCA employees their real connection with another all-important phase of the war. In the contest announcement, a cordial letter was inclosed to each RCA employee from the employees of the Alabama shipyards, including this paragraph:

"Realizing that close cooperation between industries is the keynote in our 'Beat the Promise' effort, we feel that this event is particularly significant as evidence of the 'if we build it, *you'll* ship it' spirit. Together, we'll beat the promise and the Axis."

For all its well-known complexities and all its frequent failures, the suggestion system remains the very crux of most successful production drives. This fact is given recognition by the manner in which WPB has emphasized the suggestion system activities of the 2000-odd labor-management committees registered.

One year after the beginning of the drive, Chairman Nelson was able to announce that a total of 600,000 suggestions had been submitted to committees by workers as a result of the drive. To stimulate participation, WPB maintains a Board for Individual Awards, which reviews the best suggestions sent in by committees and periodically chooses a group for special attention. Certificates of Individual Production Merit are sent to outstanding contestants, while letters of honorable mention go to the runners-up. On one occasion ten of the authors of exceptionally useful suggestions went to Washington to be honored at WPB ceremonies.

## Plant Visits by Servicemen —*Independent Pneumatic*

An interesting sidelight on plant visits from men in the armed services is provided by this comment from the Independent Pneumatic Tool Company, which notes a "spontaneous reaction" to such visits, but observes: "This is particularly true if the men are not officers and have seen action."

The company's magazine, "Thor Scoreboard," carries a generous amount of servicemen's news in addition to advancing every form of employee war activity.

## War Production Clinics— *Curtiss-Wright*

Well pleased with the results of its own war production drive program, the Curtiss-Wright Corporation decided to share its findings with its 1500 subcontractors and vendors in the East and Middle West.

Hence the Curtiss-Wright war-production clinics, the first of which was launched with a three-day session in New York on May 12 to 15, and was followed by others in Cleveland, Detroit, Chicago, and St. Louis.

Displays, talks, and panels were held at which Burdette S. Wright, vice-president, and other Curtiss-Wright officials explained the workings of the company's "100 Percent Production Soldier" program which greatly improved attendance and output in the Airplane Division. While intended primarily for Curtiss-Wright subcontractors and vendors, the sessions were thrown open to all manufacturers interested in increased war production.

With "Back Up Our Battleskies!" as the slogan, Curtiss-Wright employees sign a pledge to the armed forces of the United States promising their best thought and effort to the production task at hand. A basic plastic pin is issued, to be replaced by a silver pin at the end of six months for those who earn the "credits" qualifying them as 100 percent Production Soldiers, and by a gold pin for the final six months.

## "Production Soldiers"— *Marmon-Herrington*

There are "Production Soldiers" not only at Curtiss-Wright but also at the Marmon-Herrington tank plant in Indianapolis. Factory whistles no longer blow at Marmon. Instead, regulation Army bugles blow reveille for starting time, mess call for lunch,

and retreat for the end of the shift. Each day begins with a flag-raising ceremony.

No longer do workers file down prosaic aisles to work in colorless bays. When you ask the whereabouts of Joe Smith, you'll hear:

"He's on MacArthur Avenue," or it may be Eisenhower Boulevard—or Joe Foss Street.

The streets between the buildings are called Burma Road, Tunisian Trail, Alcan Highway, and so forth. The plant hospital is the "Medical Corps," the main office is "General Headquarters," and the personnel building the "Induction Center." The test and proof range, where shells blast constantly against armored plate, is called "Malta."

## Wide Use of House Organ—*Easy Washer*

Nearly every alert company magazine published by industrial firms features letters and pictures of employees in the armed services. Many publish special supplements or editions, a notable example of which is "The Easy Broadcaster," a monthly newsletter sent to training camps and battlefronts all over the world by the Easy Washing Machine Corporation of Syracuse, N. Y.

There are a few "domestic" items in the "Broadcaster" of the sort which might interest any absent employee, such as news of a new plant building, and a report on the 10-Year Club's dinner given in honor of servicemen. The rest is given over largely to letters from servicemen themselves, plus changes of address, a few poems, and a picture or two.

The principle back of this policy looms as one of increasing importance. It is that in the plant there is no substitute for the sort of morale that springs from the consciousness that friends, brothers, or sweethearts of employees are undergoing privation and facing real danger. As the war enters its grimmer phase, as casualty lists roll in, the news, good and bad, from the war fronts will touch off a new determination, a new fire in the hearts of most workers.

Conversely, the serviceman gets almost the same "lift" out of a thoughtfully edited employee magazine as he does from a letter from home. He appreciates seeing his name or some record of his achievements in print. Such recognition is about all he gets for his sacrifice. And he thinks more kindly of the employer who remembers to honor him.

Naturally the serviceman wants to read home news about people whose minds are on the war, on production drives, war bond drives, ride-swapping campaigns, victory gardens, and the like. It would obviously be a grave mistake to annoy a sweating soldier in a foxhole with house magazines featuring news about jitterbugs, barflies, and bowlers. And, to the credit of industry's house magazine editors, there is an absolute minimum of senseless social items and news about clambakes and sports events in the publications they are putting out.

**No chance for employees at Marmon-Herrington, Indianapolis, to forget they are working to win a war. Bugle calls have replaced the factory whistle. Aisles are named for famous war personages**

## Christmas Bonus Checks for Company Employees in Armed Services—*Acme Steel*

Maintaining close contact with the serviceman, as a company policy, as a morale objective, and as a post-war measure of great significance, is beginning to engage the attention of progressive managements.

A pioneer in this activity is the Acme Steel Company of Chicago. Acme's men in uniform never have to spend a doubtful moment wondering whether the company has forgotten them and whether they'll get their jobs back after the war. No matter what uniforms they wear, no matter where they are, they are still Acme's men. And the company reminds them of this fact in tangible ways:

1. Christmas bonuses, equal to the amount they would have received had

they remained on the job, are sent to them wherever they go.

2. Seniority accrues to them on the same basis as before.

3. Vacation checks are mailed to them for the amount that would have been due them on the basis of accrued seniority.

4. Wage increases retroactively adopted for hourly paid employees in the steel industry last August were automatically applied to the pay status of those who worked during the period of the increase before entering the service.

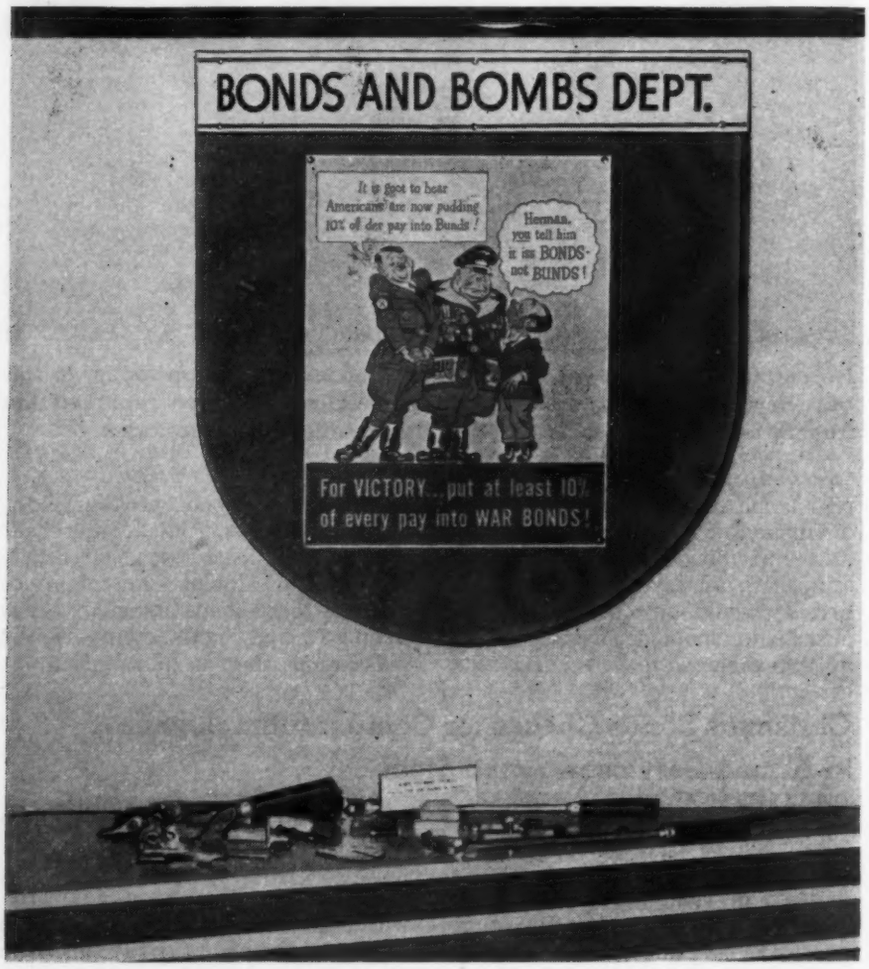
Acme employees have an additional reason to remember the company kindly because, when they entered the service, they received a remittance of the premiums paid on their group life insurance. And with all these inclosures have gone friendly letters from plant executives. In one letter G. T. Avery, works manager of the Riverdale plant, described the Christmas trees in the restaurant and the plant entrance, told something about the company's war production records, and said:

"The inclosed check is a visible reminder that you are still one of the Acme family whether you have been in the service only a day or a year or more . . . It has been a great pleasure to receive your letters from the different camps and countries, and I hope you will write to me whenever you can. I always pass your letters along to the *Acme News* so that all Acme-ites may share in your interesting experience."

Here is an equally typical quotation from a letter by John Ekern Ott, plant manager of the Archer Avenue plant, to the wife of a prisoner of the Japanese (also inclosing a Christmas bonus check).

"We all hope we will soon find an end to this war—a victorious end—and that when we do, Frank will come marching home with many interesting experiences with which to regale us all, even though he has to suffer the deprivations that we all know go to those who spend any time in a Japanese prison camp. However, until you do get him home, we will extend our wishes to you in his place. We wish you a Merry Christmas and a Happy New Year."

The hundreds of letters of appreciation received by the company ring with an unmistakable sincerity which augurs well for the continuance of Acme's long record of harmonious labor relations. As V. C. Hogren, advertising manager, observes: "It seems to us that industry has an obligation to the men and women who have left to fight for their country. These people will return to civilian life, and their influence will determine the type of government under which America will continue to operate for generations to come."


BONDS AND BOMBS DEPT.
It is said to hear Americans are now padding 10% of der pay into Bunds!
Herman, you tell him it is BONDS- not BUNDS!
For VICTORY...put at least 10% of every pay into WAR BONDS!

**Broken tools win no wars, but buying bonds will help. To emphasize these facts, Acme Steel makes prominent displays of tools that have been carelessly handled. Eye-catching posters sell the idea**

## Contest to Reduce Absences—*Harnischfeger*

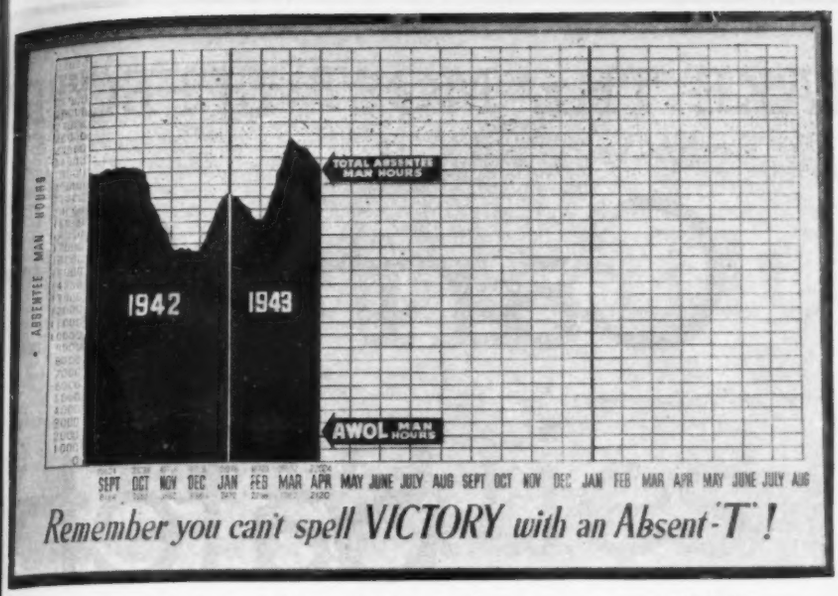
From 8184 man-hours lost in September to 1216 lost in May is the outstanding record of the fight waged on absenteeism by the Harnischfeger Corporation, Milwaukee. A labor-management committee got solidly behind the drive for regular attendance at this "E" award plant where war-vital handling equipment is made.

"AWOL" lost hours are dramatized on a bulletin board with the slogan, "No soldier son of yours or mine will thank us much for this lost time." And the threat of inclusion by name in half-inch letters on a "slacker list" bulletin board also does much to encourage regular attendance. In cases of unexcused absence, a polite letter is first sent to the employee's home, addressed both to the worker and his wife on the theory that women are sensitive to shame and responsive to patriotic appeals. Sharper letters follow, if no improvement is noted, and then inclusion in the "slacker" list. Chronic incurables are discharged.

## Contest to Improve Plant Attendance—*Bristol*

Interdepartmental attendance contests, conducted by a subcommittee of the labor-management committee at the Bristol Company's plant in Waterbury, Conn., produced a gratifying average of 93.7 percent attendance (i.e., of people neither absent nor late) in midwinter when traveling conditions were toughest.

From each department's daily score half a point was deducted for the lateness of an employee, a full point for absence. The contest was greatly


ABSENTEE MAN HOURS
TOTAL ABSENTEE MAN HOURS
1942
1943
AWOL MAN HOURS
SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG
Remember you can't spell VICTORY with an Absent-'T'!

**War on absenteeism at Harnischfeger Corporation cut AWOL man-hours from 8184 last September to 1216 in May of this year**

stimulated by specially planned posters keyed to current events, such as excerpts from Captain Eddie Rickenbacker's first press interview on his return from the Pacific, and a quotation from an article in *Time* in which the need for more Bristol products in the anti-submarine war was specifically mentioned. Members of trophy-winning departments were photographed for the company magazine.

As a consequence of the attendance campaign, the company was asked by the committee to request increased service from the local bus company. The request was granted.

## Share-the-Ride Plan for Solution of Worker Transportation Problems—*Gould & Eberhardt*

The importance of the *direction* of an employee's residence, rather than the zone, is stressed by Gould & Eberhardt, Newark, in the formation of ride-sharing groups. The result, according to Granger Davenport, chairman of the company's transportation committee, is a pronounced decrease in paperwork.

"The disadvantage of the rectangular zones is that, after an employee is so classified, his ride-sharing possibilities are likely to be restricted to those in his zone," Davenport points out. "Making contact with riders or car owners in his zone becomes difficult and requires reference to maps and consultation with members of the transportation committee. On the other hand, the simplicity of classifying primarily by direction and secondarily by distance minimizes employee effort in locating and obtaining riders and other car drivers."

At Gould & Eberhardt the employee is first classified by shift, next by compass direction of his residence from the plant, and then by approximate straight-line distance (to the nearest mile) from his home to the plant. The committee uses large-scale maps marked off in radial circles a mile apart to a distance of 10 miles from the plant. Code classification of the employee comprises a number representing the shift, then a hyphen, then the direction in which he lives from the plant, then another number representing the distance in miles. These code classifications are listed on the bulletin board under his shift and under the proper column.

"Suppose, for example, a man finds his name under the 77 shift with the classification E6," Davenport says. "All his neighbors living in a general easterly direction and approximately 6 miles from the plant are known to him at once . . . The clock and department numbers being listed also on the bulletin board along with the names makes it a simple matter for an employee to form his own car-sharing group."

An additional advantage of the plan is that the sizes of the zones increase with the distance from the plant. Thus two employees 20 miles from the plant may double up even though they each may have to go five miles out of his way to pick up the other. In the regular rectangular zone system, such an opportunity might be overlooked.

## A Bulletin Board That Broadcasts—*Miller*

A "broadcasting bulletin board" puts life and sparkle into company announcements at the Meriden, Conn., plant of the Miller Company. "This is an innovation which seems to us to be especially desirable for medium-sized plants not equipped with sound systems, and one which will greatly broaden the effectiveness of sound systems already installed in the larger plants," Harry L. Harrison, director of public relations, points out.

There are two boards at each entrance to the Miller plant. Each board consists of a 10-ft. center panel flanked by 4-ft. side panels containing the Miller honor roll of employees.

Posters are displayed on the center panel on which is also depicted the "Miller Elf" (a familiar company symbol), who holds a megaphone. The amplifier in the center of the megaphone broadcasts music and announcements piped from the "control room" where it can be hooked up to a phonograph or radio or a microphone.

Workers entering in the morning receive a cheery greeting from the Miller Elf and an admonition to "Work Safely," or "War on Waste," or "Buy War Bonds." Latecomers hear the derisive "Oh, how I hate to get up in the morning."

"The boards are in action every moment of the time that workers are coming in or going out of the plant," Harrison says. "They attract, and they receive, interested attention. And, as the eyes of the workers turn to the board, they not only hear what the Miller Elf is saying, they see the honor roll, they see the posters, and both of these get extra meaning from the broadcasting."

* * *

As the war wears on, the trend to wider utilization of the labor-management cooperation principle appears to be on the upgrade. Granted that the War Production Drive has been, basically, a war measure, it seems likely that both management and employees of many companies will remember the improvement in labor relations, as well as the increased production and efficiency, which so many of these campaigns brought forth. Thus it may be assumed that the post-war future of labor-management cooperation is destined to be a bright one.

# HOW TO MAKE THE MOST EFFECTIV

# STEP 6 Carry On

# Safety

MARKED NEW TRENDS in the field of industrial health, the most notable being an acceptance by employers of many new responsibilities for the maintenance of their employees' health, rise out of these general conditions:

1. The job of war production, generally speaking, is being done by the *weaker side* of the nation's population—the older men, women, and younger men who could not meet the physical requirements of the armed services.

2. Even in normal times a greater incidence of disabilities could be expected among this group.

3. In addition, this less-fit group is working at a faster pace and for longer hours than American workers were asked to work before.

4. Medical services for civilians are far less available than normally.

5. The supply of food available to the civilian population has greatly diminished, and the prospects are that it will continue to diminish.

Even though we are depending as much upon industry as upon our armed forces for the winning of the war, the means for maintaining the health and morale of war workers are greatly inferior to those for the various services. While soldiers are selected on the basis of careful physical examination, and while the best is provided for them in the way of medical care, housing, and transportation, industrial workers are given relatively cursory physical examinations when hired, and, although shielded from occupational accidents and diseases, are generally left to their own devices in the matter of caring for their physical well-being.

## Medical Services

Industry has always had a health problem, but the present one has assumed such great proportions that it appears to demand an entirely new kind of thinking on the part of management in approaching it. Although the growth of industrial medical care up to the coming of the war was principally motivated by considerations of benevolence or efficiency, in this crisis neither philosophy will suffice; total war transcends both of them. Today industry's responsibility for protecting workers against occupational accidents and diseases is only primary; health maintenance activities must extend beyond the plant (largely through education) into the worker's physical environment. The trend in that direction, especially among companies that had good medical care programs when the war began, is evident and arises principally out of the conditions cited.

All that companies have formerly done in the way of pre-employment physical examination, protecting workers against occupational accidents and diseases, and regular physical check-ups, must be continued. But the more comprehensive approach includes influencing the worker's eating habits, assisting him in getting medical care, educating him and his family in nutrition, encouraging wholesome recreation, teaching the principles of health maintenance, guarding him from overstrain and fatigue.

The government, fully appreciating the inadequacy of the civilian medical services, realizes that employers, large numbers of whom already have organized medical programs, are in an excellent position to assist in maintaining the health of the industrial army.

Most employers do not feel that

USE OF MANPOWER

# Health and Activities

"Laugh and stretch" is keynote of Vega induction program which takes aches out of tired muscles and eases switch from kitchen to factory. The leader is swimming champion Olive Hatch who worked on the production line long enough to find out what exercises are most needed. Case study on page 140

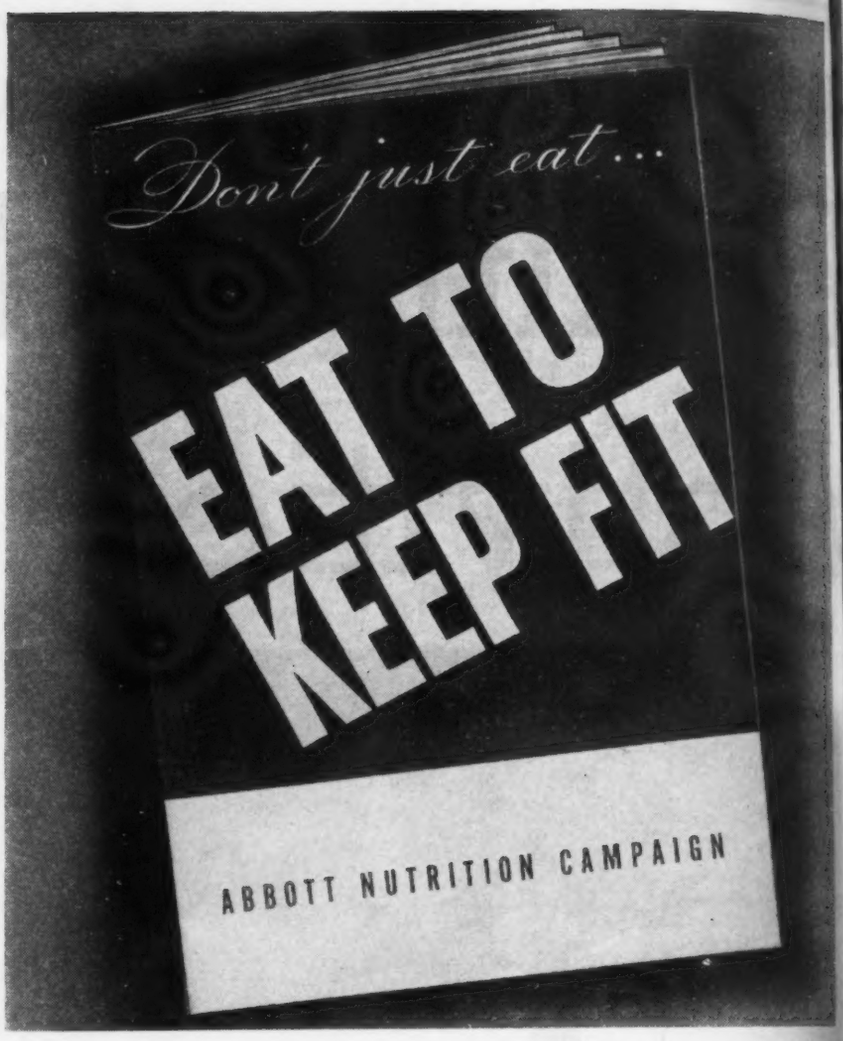
they are "being put upon" in being asked to assume these increased responsibilities. As far as medical programs themselves are concerned, previous FACTORY articles and studies by private organizations have shown that they pay, and that the employer can go a long way in spending money for employee health maintenance before he reaches the point of diminishing returns. This goes also for the small company, as shown by the study of the National Association of Manufacturers, "Who's Too Small for a Health Program?"

Regarding the direct value of adequate medical programs, Dr. Victor G. Heiser has given the following estimates: Such a program will reduce accident frequency by 45 percent, absenteeism by 30 percent, occupational diseases by 63 percent, labor turnover by 27 percent, industrial compensation insurance by 29 percent. Nor do his figures take into account the increase in efficiency that can be achieved by having employees up to par physically, at all times.

Of what does an ideal industrial medical service consist? A program containing the following features has been considered typical of the ideal type and was suggested by Dr. C. O. Sappington, well-known student of industrial medicine:

1. Health service set up and conducted by full-time physicians
2. Full-time dispensary nurses
3. Pre-employment examinations
4. Supervision of the correction of physical defects found on examination
5. Periodic re-examinations
6. Diagnostic service
7. Continued study of occupational safety and health hazards
8. Complete treatment and rehabilitation of all occupational injuries
9. Minor operations
10. Treatment for minor illnesses
11. Special eye examinations
12. A mutual benefit association for employees
13. Provision for group insurance
14. Visiting nursing service
15. Rendering of periodic reports to the family physicians
16. Mental tests or examinations
17. Dental services
18. Provision for sanitarium privileges for those who need this service

Not all companies have developed their medical services to such a point as to embrace all these features, but it is a rare concern that does not have some kind of medical service, whether it be first aid instruction in some very small concerns, to fully equipped hospitals in others. It is no secret that in many instances plant hospitals have had to be created since the war began because of the lower-than-standard physical condition of job applicants. The strain of long hours and irregular shifts tells more quickly upon such workers than upon those in normal physical condition.




**Big gun in nutrition campaign launched by Abbott Laboratories is red, white, and blue booklet (6x9 inches). Plan was tried out on supervisors before presented to workers. Case study on page 142**

## Employee Nutrition

There is evidence that the families of American workers have for many years been existing on diets far below the level considered adequate by leading nutrition authorities. This was true in the years before the war, and the situation certainly has not improved with food rationing.

It is accepted as a general truth upon the basis of the studies made by the Committee on Nutrition in Industry of the National Research Council that the wife of the average industrial worker does not know how to buy food to derive the most nutritional value from it.

It was solely for the purpose of instructing housewives in good food "buymanship" that Westinghouse, for example, instituted its "Health for Victory Club" movement. Clubs have been set up in many plants. Every homemaker is eligible for membership in the club. Each month, members and local food merchants receive copies of a food guide containing menus that are both nutritious and appetizing. In preparing them, such factors as sugar rationing, growing seasons, yields of fruits and vegetables, and impending shortages are taken into consideration. Recipes are given for every unusual item, in addition to basic rules for frying eggs, boiling potatoes, making Irish stew, and rules for using

grease drippings in homemade soups.

As far as in-plant feeding is concerned, Westinghouse and hundreds of other companies have given careful study to the problem of insuring that the employees make the right choice of foods in plant cafeterias and from mobile canteens, which have become highly popular. Observations by federal health authorities show that merely providing the most nutritious foods for employees gives no assurance that the employees will select them from the array in the plant cafeteria. The Council on Foods and Nutrition, and the Council on Industrial Health of the American Medical Association, recently reported that a qualified nutritionist who classified 700 lunch trays passing through the cafeteria line of a New England plant considered 390 of them inadequate and 310 of them good. Similar conditions were found in other plants. The committee asserted that much can still be done to improve nutrition of the industrial worker "through careful examination of present facilities to see that they are most effectively used."

With respect to the whole nutritional problem, then, the key is *education*—education of the housewife through employee magazines, leaflets, and lectures on the provident use of ration points, on the selection of seasonable and nutritious foods, on how to pack lunches; education of the employee on such matters as the preference of milk and fruit juices to soft drinks, the value of victory gardens, and the selection of the more wholesome foods in cafeterias.

Neglect of nutrition is especially prevalent in the more crowded industrial areas where "one-arm joints" specializing in fried foods, coffee, and doughnuts have mushroomed around the plants. In many cases companies have discovered that large numbers of the employees had to travel so far to work that they did not take breakfast at home at all and ate their morning meal, usually consisting of coffee and "sinkers," in such places.

**A booster for vitamin pills is Electronic Laboratories which gives each employee a strip of seven every pay day. To them the management attributes an increase in output. Case study on page 141**

## The Vitamin Question

The mass administration of synthetic vitamins, whether or not it is a good practice, is a moot question. The American Medical Association and the Committee on Food in Industry take the stand that the only sure way of maintaining proper nutrition, in the long run, is through the daily consumption of natural foods containing the proper amounts and kinds of nutrients.

As for the indiscriminate administration of vitamins to workers, the Council on Foods and Nutrition and the Council on Industrial Health of the AMA are emphatic in their disapproval. These authorities state that the practice is "irrational from the therapeutic point of view and therefore has no place in a program aimed at securing industrial health. It is unwise nutritionally, because special vitamin preparations cannot take the place of valuable natural foods in achieving the completely satisfactory nutritive state. Finally, because a good diet can provide all that vitamin preparations have to offer and more in this connection, the mass administration of vitamins is uneconomical."

However, many other authorities, including industrial physicians, who have had experience with mass vitamin administration in plants, stoutly defend the practice. While agreeing that it is more desirable to provide vitamin content by way of the food itself, they point out that the vitamin content of fresh foods is highly variable and that administration of vitamins is insurance against this variability. For example, the vitamin content of many foodstuffs varies with the seasons; there are vitamin losses in transportation, and further losses in the preparation of the food.

One impressive example of vitamin starvation in the midst of plenty is the case of a group of workers in the Lockheed plant in California, in which it was found that nearly 45 percent of the employees were suffering from a deficiency of vitamin C. Even though the men were living in the heart of the citrus-fruit area, they were lacking the vitamin most easily within their reach. A common reason for the condition, study showed, was that the workers always took their vitamin C in the form of juice at breakfast, but took it only when they got up in time.

There is also a considerable body of medical opinion that holds that vita-

**Basket ball is up near the top of the long list of sports provided for in Minneapolis-Honeywell's recreation program, which emphasizes physical, cultural, social activities. Case study on page 143**

mins can be valuable in correcting kinds of working conditions. For example, it is known that workers exposed to toxic chemicals need a suitable vitamin content in their daily food, particularly vitamin C, and vitamins of the B group. This has been found important in TNT production, shell loading, and plants in the rubber industry in which workers are exposed to benzine.

## Recreation and Morale

The building of morale through recreation has assumed new importance with the coming of the war. Experience has shown that recreation programs pay their way, and have an additional beneficial effect upon productive output. The idea of providing recreation for industrial workers, however, is not an entirely new one. It was long ago realized that a company with recreational facilities attracted better citizens, and that these facilities tend to make the employee take pride in his company and its name. Further, teamwork on the ball field extends to the production line and stimulates a wholesome type of comradeship among members of the working force. Some of the fundamentals of a good program are:

1. Top management must believe thoroughly in the value of the program, and should take a long-range view of its benefits.

2. It should not be promoted by a paternalistic kind of thinking on the part of the company.

3. The employee should participate in the administration of the program.

4. The program should include all types of recreational activity, from bridge to baseball, so that everyone can participate. And it must be the kind of program the employee wants.

## Safety Problems

The National Safety Council has issued fundamental suggestions for approaching the safety problem:

1. The initial job of the man in charge of safety is to conduct an analysis of past plant accident reports and records. This analysis should bring to light certain salient facts. First of all, departments should be rated according to their accident experience, thus giving a clue to where corrective efforts should begin.

2. Conditions, agencies, and practices causing accidents are found, and here, also, immediate steps for improvement may be taken.

3. The weak and strong points of certain foremen and supervisors, as they relate to accident prevention, are found. When additional education in safety is indicated, the safety director knows where to direct his efforts.

4. Individual workers suffering repeated injuries are discovered. With this information available, the safety engineer may determine the causes for these accidents; whether due to physical handicaps, wrong mental attitudes, or lack of training or skill.

Too much emphasis cannot be placed upon organizing and maintaining a complete injury-reporting system. To the safety man, the use of plant accident statistics can be as valuable as the cost sheet to the production manager.

Extensive plant inspections are made, to include machines, tools, fire hazards, fire protective facilities, electrical hazards, chemicals, lighting, ventilation, and housekeeping. All materials handling equipment, tools, ladders, and power transmission apparatus are thoroughly checked. The safety man assists in this work, but places considerable responsibility on foremen, supervisors, and employees.

Intensive efforts are made to secure the wholehearted cooperation of workers in the safety program. An appeal for this cooperation may be communicated by personal letters from management, through bulletin board announcements and departmental meetings, or at meetings of employees. Wide publicity should be given the effort, and every means at the disposal of management used to arouse interest and a desire for cooperation.

Many accidents have occurred because workers have been placed on jobs for which they were physically and mentally unqualified. In certain occupations, workers are especially liable to injury if they have physical defects, such as defective vision and hearing, or are below par in some other way. Workers are often unaware of any physical defects previous to physical examinations. Following examination, conditions may be corrected by placement, and adjustments made to new occupations, reducing the likelihood of injuries.

Consequently, the selection and placement of workers is an important factor in controlling accidents. If a worker is selected on the basis of a thorough physical examination, in addition to other requirements, accidents resulting from physical deficiencies will be reduced to a minimum or entirely eliminated.

A further aid can be obtained by efficient and thoughtful supervision. Workers under lax supervision are apt to take chances, to use short cuts, and to remove guards, all of which lead to many of the so-called "unforeseen accidents." It is frequently the simplest and smallest operations, overlooked by the supervisor, which result in injuries. Attention to minor details, proper instruction and training, followed by close, personal supervision will go far in controlling injuries.

Highly important is the organization of plant safety committees. They generally consist of a general safety committee, a foremen's safety committee, an inspection committee.

The general safety committee is the policy-forming group in matters affecting plant safety. Its membership may vary from four to any greater number, but it should always be made up of an executive, a foreman, a worker, and the man in charge of safety. If more than four members are appointed, the balance between foremen and workers is maintained. Meetings are held at regular intervals, usually once a month, and records kept of the proceedings.

The foremen's safety committee is a working committee that applies the general program directly to problems in the department. The membership is composed principally of foremen, but it is always desirable to have several workmen in the group. Again, the size of the committee varies according to conditions, but it is well to have this committee as large as possible, since it is a valuable means of training both men and supervisors.

The plant inspection committee consists usually of a foreman and two workmen who make weekly or monthly inspections of the plant for the purpose of discovering and having corrected unsafe conditions and practices. Holes in the floor, unguarded machines, unguarded construction, openings, poor housekeeping, defective machines, or, in short, any condition likely to cause injury to men or to interrupt production, are examples of physical hazards they single out and have corrected.

* * *

Appended are case studies from sixteen plants, each item highspotting some one phase of the problem of maintaining the health of industrial employees. Studies are grouped in the same four major classifications—medical services, nutrition, recreation, and safety—that have been treated in the foregoing discussion.

## An Intensified Medical Program for War Workers' Health—*General Motors*

Examinations of new employees at General Motors Corporation have been at the highest rate in the company's history. Over 55,000 workers have joined the armed services; about 190,000 new people have been employed during the last year.

New health hazards have been many, testifies H. W. Anderson, vice-president in charge of personnel, but medical departments have been on the alert and have protected employees from many harmful exposures. Dermatitis caused some trouble, but only 92 cases in the whole organization necessitated any lost time. Last year, as a matter of fact, General Motors had only 130 cases of lost time due to occupational disease of any kind.

The medical organization consists of 65 full-time and 46 part-time doctors (including 5 women physicians); 143 attendants, technicians, and laboratory aides; 452 registered female nurses; 78 clerks—a total personnel of 784. Their responsibilities are great; they are look-

ing after the health of 390,000 war workers, and it is expected that this number may increase to 500,000.

The employment of handicapped people, Anderson reports, introduces special placement and health maintenance problems. Both job and applicant must be studied. Suitable instruction is necessary, and there must be close follow-up until these people become seasoned. This is an important job for the medical departments, and it is a way of preparing for the reabsorption of employees returning from military service during and after the war.

Doctors and nurses in the plants are close to the employees. Professional relations with them result, many times, in the outpouring of confidences, and there is no one in the industrial organization better fitted to listen sympathetically, patiently, and helpfully. This is recognized as a service of great value, and is cultivated as far as possible. With the increased employment of women, nurses particularly will find increasing demands of this nature upon their time, and it is contemplated that certain of them will gradually take on counselor functions to the exclusion of their nursing duties. General Motors believes this is a logical and desirable development in the medical department.

## Laugh and Stretch Plan for Women—*Vega*

"Laugh and stretch" is the keynote of the "kitchen to factory" program inaugurated by Vega Aircraft Corporation, Burbank, Calif.

All newly hired women shop workers are placed in an induction department before being permanently assigned to a production job. During this four- or five-day stay they are taken outdoors to a recreation area twice a day and put through physical training paces by Olive Hatch, famous swimming champion.

The first step is to get the women in a laughing mood. Laughing is relaxing. Then come stretching exercises and massage—things a woman can do in her own home after a day's work or right beside her bench or work station. A sore forearm or shoulder may result from holding a rivet gun improperly. Climbing on jigs may cause aching leg muscles. The "work induction" group is shown how to overcome these temporary ills by stretching and pulling exercises, shaking the wrists to bring the blood to the forearms, and massage.

Other exercises include massaging the base of the skull or the muscles of the eyes; lifting the feet, pointing the toes, and rotating the entire foot; clasping hands and pulling; completely relaxing by bending the head down until it touches the knees, with arms swinging loosely.

**Always a "man's company," Monsanto tells women how important company products are in the war, outlines health and safety rules**

## Booklet With Pointers for Women—*Monsanto*

Addressed specifically to the women who are now taking men's jobs is a booklet called "Women of Monsanto." Simply written, beautifully printed, with the more important instructions in red type, this pamphlet tells first how Monsanto Chemical Company has always been a "man's company," then goes on to explain the importance of the Monsanto products in the war.

Health rules are outlined. Women are urged to consult the company doctor or nurse about any physical disturbance. Diet, rest, relaxation, recreation, all are treated.

Safety is treated extensively—reason for uniform, why hairnets are necessary, why jewelry is a real hazard, list of instructions on how to lift heavy articles.

"The cleanliness, safety, production, and absenteeism records of a plant," reads the final paragraph, "are the responsibility of each employee. Only by the cooperation of all can a desirable standard be maintained. All the rules and privileges of a plant apply to women as well as to men. As to personal conduct, it might be well to keep in mind the instruction received by your sister war workers, the WAVES, when they enter service, 'Remember you are ladies, but forget you are women'."

**To assure food for its cafeteria, Denison Engineering Company acquired 650 acres of farm land, half to be used for company gardens, half for raising poultry and pasturing cattle, sheep, and hogs**

## "Beat the Heat" Drive—*Carnegie-Illinois*

Heat sickness can be a serious problem during the summer months. It may take the form of heat cramps, heat exhaustion, or heat stroke—and any form can result in death.

At Carnegie-Illinois Steel Corporation, a program has been developed to prevent heat sickness. Educational materials consist of a booklet, "Eat the Right Foods," and a technicolor sound movie, "Beat the Heat." Ten brief hot-weather rules are given to show the workers what they can do to prevent heat sickness, and what should be done in cases of heat sickness. Foods that may be eaten plentifully, and those to be eaten sparingly before and during work, are listed.

The actual campaign is launched early in the summer during a plant-wide "Beat the Heat" week. Immediately before this week, the plant surgeon meets with the supervisors for a discussion of the causes and prevention of heat sickness. The part the foremen must play in enlisting cooperation of workers is emphasized.

During the campaign, each foreman speaks to each worker in his department, either individually or in small groups. He gives everyone a copy of "Eat the Right Foods," and emphasizes the importance of: (1) Recognizing the early symptoms of heat sickness; (2) prompt reporting to the foreman after the symptoms have appeared; (3) hourly use of "Beat the Heat" wafers or jellies; (4) diet.

Follow-up individual contacts are made frequently during the hot weather. Thus the supervisor can spot the men most susceptible to heat sickness. Department "hot spots" are found, and everything possible is done to eliminate unfavorable conditions.

The campaign is not a one-contact, one-week, or one-month program, but rather one that necessitates month-to-month and year-to-year interest. The first Carnegie-Illinois plant to use it began in the summer of 1939. That year there were 551 cases of heat sickness; in 1940 there were 290; in 1941, 140; in 1942, only 67—all in spite of steady increase in man-hours.

## Vitamins for Victory—*Electronic Labs*

Vitamin pills can be an effective weapon in the fight against absenteeism—and in stepping up production. That is the considered opinion of Electronic Laboratories, Indianapolis, where a "Vitamins for Victory" program was introduced to the 1000 employees early this year.

The plan caught on without the usual selling campaign. Workers were reminded that vitamins are being used to build the strength of the fighting forces, and they were told their pills would be supplied free of charge. There has been 100 percent participation in the program.

Pills packed in cellophane by the company nurse are arranged in strips of seven so that one can be torn off each day in the week. The strips are distributed on Thursday with the pay checks. Each morning, usually during the rest period, the employee takes his pill.

For workers who want their families also to benefit, pills are made available at cost.

Within the first vitamin month, says the management, production figures showed that output was stepped up 10 to 15 percent. Employees had a brighter outlook, were more pleasant in their relations with one another and with the management, and they contributed more shoulder-to-the-wheel cooperation.

Absenteeism due to illness dropped immediately, and is still declining. It is to the vitamin-taking program that the management of the plant attributes the ability of employees to maintain peak efficiency throughout a 7-day, 56-hour work week.

## Food From Farm Project—*Denison Engineering*

There will be no shortage of nourishing food in the cafeteria in the Denison Engineering Company, Columbus, Ohio, if the management has its way. The president, W. C. Denison, Jr., believes that fresh, nutritious foods are just as important for his workers, who produce oil-hydraulic machinery and test equipment for the Army and Navy, as for those who use that equipment.

The company, therefore, has inaugurated a "food insurance" program. About 650 acres of farm land was

acquired, half to be cultivated, the other half used for poultry raising and as pasturage for sheep, cattle, and swine.

As a result, the cafeteria is assured a steady flow of fresh foods through this farm project. Surplus food is sold to workers through a company store arrangement, at reasonable prices. Workers have been informed that this will in no way conflict with the government's food rationing program; all rationed foods will require the surrender of the proper coupons.

## Ready-Made Cafeteria—*American Machine*

One way to get a plant cafeteria is to buy one that is already established and move it, with its manager, right into the factory.

That is exactly what American Machine & Metals, Inc., East Moline, Ill., did. When the management realized that good food on the spot promotes health and cuts down absenteeism, it bought the furnishings and fixtures of an operating cafeteria and persuaded its manager to continue his job in the new location.

The cafeteria occupies approximately 5700 square feet, accommodates more than 900 workers daily. About 600 men and women on the day shift eat their noon meals there. Departments are released at 10-min. intervals, so that there is a steady flow of traffic past the serving counter.

Because the one centralized unit is easily accessible to all, no food trucks go through the plant. However, push wagons carrying coffee and sweet rolls or doughnuts are wheeled through the plant, by girls in brown and beige slack suits, from 9 to 11 a.m., 2.30 to 3.30 p.m., 8.30 to 10 p.m., and from 2 to 3 a.m., in order to service all shifts.

## "Eat to Keep Fit" Drive—*Abbott Laboratories*

Because so many workers do not choose the proper foods to keep well and to keep working, Abbott Laboratories, North Chicago, Ill., launched a campaign to educate them in the right methods of eating for health.

The value of good nutrition had first to be proved to office and factory managers and department heads, before any successful campaign could be started for all employees. Therefore the "Eat to Keep Fit" program was announced at a regular monthly managers' meeting. Fundamental facts in the field of nutrition were explained. The medical department presented

**Home talent from the maintenance department provides the music for noon-hour square dances at General Electric's Pittsfield Works**

figures taken from a survey of eating habits of employees over a week's time. Details of the Abbott nutrition campaign were outlined. A short skit, written and produced by the advertising department, dramatized the value of good eating.

During a week of intensive promotion following the managers' meeting, all types of materials were used to sell the program to the employees. Department heads distributed the "Eat to Keep Fit" booklet, urging every worker to take his copy home. In simple and attractive style the booklet supplies facts about food and nutrition, with sections on "Hidden Hunger," "Food Fights on the Home Front," "Suitable Food Substitutes," "The Vanishing Vitamin." Daily menus and food rules are included. Other fliers and pamphlets were distributed in pay envelopes and in the house mail. Posters were put up, and movies shown during lunch periods.

The week of campaigning ended with the first of a series of meetings for wives and mothers, entitled "What's Cooking?" An experienced demonstrator presented basic facts in planning and preparing meals. Many dishes were cooked on the stage and arranged attractively for serving. War stamps were given as door prizes, and the women were asked to turn in their favorite recipes, which were mimeographed and distributed.

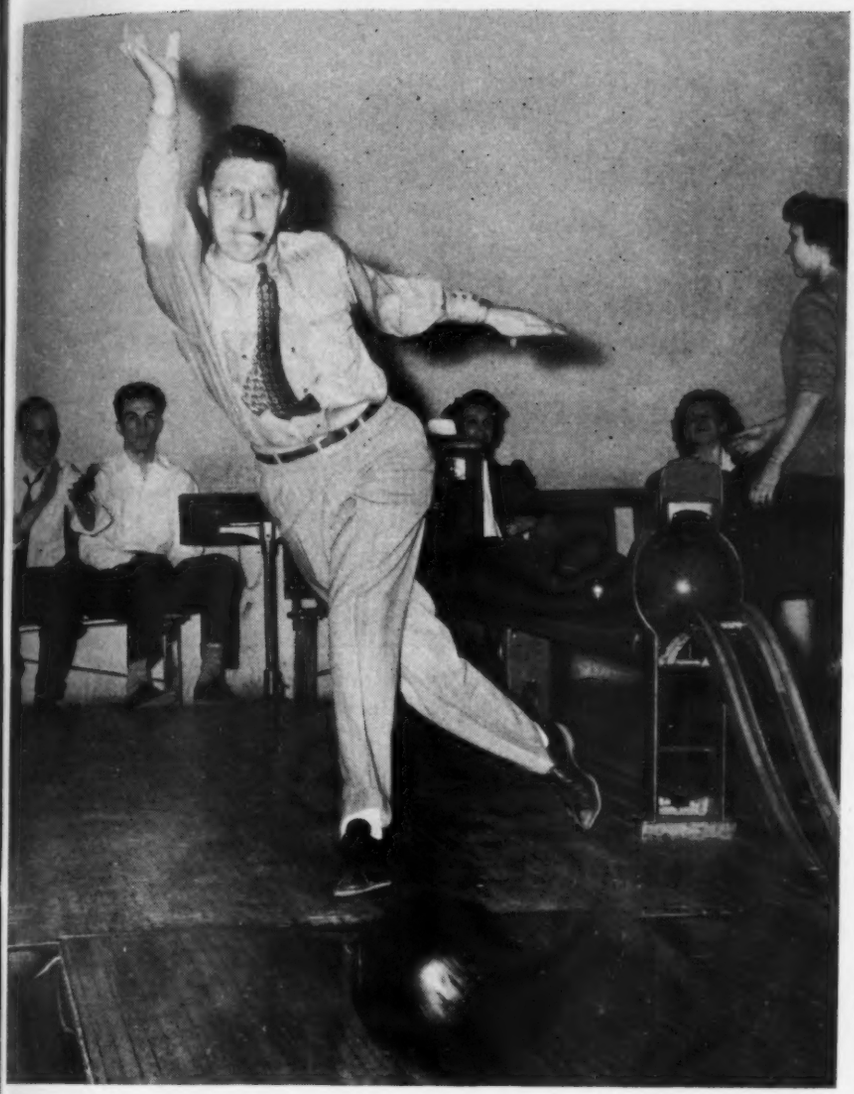
As the campaign continues the plant magazine carries an article each month on some phase of the subject. New posters are placed in the cafeteria. Movies are shown as new ones become available.

## Truck and Chicken Farm—*Wiremold*

Vegetable gardens for employees of The Wiremold Company, Hartford, Conn., date back to depression years, so in the change-over to the Victory gardens of today the company had only to enlarge the amount of land under cultivation and appoint an official labor-management committee to run the project and see that nothing was wasted.

The land not asked for by employees is being cultivated by factory people with truck gardening experience. Produce so grown will be used in the company cafeteria.

Because one of the biggest problems for the cafeteria was obtaining meat, a chicken farm suggested itself almost automatically. An employee who works full time in the finishing department added chicken care to his regular job. He is paid at factory wages for the



**At Woodward Governor, as at most industrial plants, bowling is most popular sport—but Saturday night dancing runs a close second**

time he spends on the chicks. The arrival of the first egg was heralded over the plant public address system with appropriate fanfare and cackles.

If any employee has a surplus of garden produce, he can work out a deal with the cafeteria manager. If a gardener falls by the wayside, he forfeits his plot, and the cafeteria salvages whatever it can.

## Recreational Program—*Minneapolis-Honeywell*

The recreational program at Minneapolis-Honeywell Regulator Company, Minneapolis, gets company backing and sponsorship, but it is an employee project. Supervision rests with a board of directors of the Minnreg Veterans Association—an organization of 800 male employees who have been with the company at least seven years.

At regular meetings of Minnreg's board, requests for changes in the recreational program are heard. If, for example, a request for ping pong facilities is made, and the need is established, the board allots funds from its budget.

The company has turned over the parking lot area, whose rentals supply a major part of the association's income. Additional funds come from the $1 a year dues, vending machines, and a canteen.

The recreational program includes physical, cultural, and social activities. Basket ball, bowling, golf, hockey, and softball are all popular sports with both men and women. A colorful band, whose instruments and uniforms are supplied by the Minnregs, has been organized. There are active dramatic and camera clubs.

Company-donated picnics are held once a year. Every Saturday from midnight to 3 a. m. a swing-shift roller skating party takes place.

A USO contingent sends gifts, and a monthly pamphlet goes to servicemen wherever they may be.

Since the company is situated in a fisherman's paradise, the Minnregs award a $5 prize every year on the first day of the fishing season for the largest catch.

## Square Dances at Noon Hour—*General Electric*

Members of the maintenance department at General Electric Company's Pittsfield (Mass.) Works enjoy square dancing during the noon hour. Music is provided by Ernie Schmidt's "Gloom Busters," all members of the department. Dancing is held in one of the machine shops, where the spacious floor accommodates three or four sets of dancers and many spectators.

The success of this department's lunch-hour entertainment has led other departments of the company to organize similar programs.

## Saturday Night Dances —*Woodward Governor*

Although the Woodward Governor Company, Rockford, Ill., has never sponsored or encouraged company teams, it has provided the equipment and the space for most sports which employees may indulge in at their own convenience and inclination.

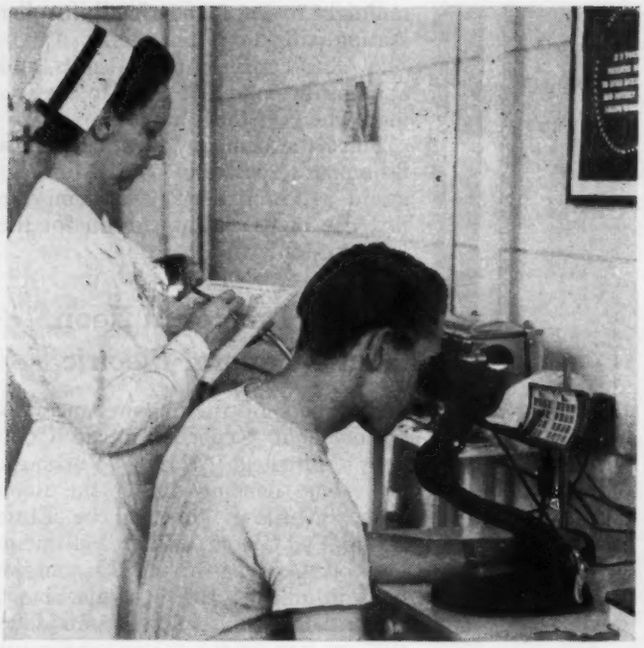
In the rear of the plant are two tennis courts, which are flooded for ice skating in the winter. There is also a softball diamond, and bats and balls are provided. Most departments on all shifts have formed teams.

The company has made an agreement with one of the city's country clubs whereby employees can play golf three mornings and afternoons a week for a very modest greens fee.

In the winter, bowling leagues are formed by both men and women. Prizes are procured out of weekly dues and distributed at a banquet at the end of the season.

For those who desire less strenuous exercise, equipment is provided for croquet or shuffleboard.

Some sort of entertainment is given for all employees about twice a month. Saturday night dances are held at frequent intervals for workers, their families, and "dates." Music is provided by records over the broadcasting system; free soft drinks, popcorn, and sandwiches are served. Games and movies are featured on other eve-



**American Welding & Manufacturing Company gives visual safety tests to workers every six months**

**Air samples are taken regularly at Caterpillar and checked in laboratory maintained for that purpose**

nings. Soldiers from nearby Camp Grant are welcome guests at any of these functions.

In this way Woodward Governor has provided inexpensive, healthful entertainment for its personnel, and has promoted the sense of well-being and comradeship that comes from participation in play outside of working hours. And all this has been done without the company's directly sponsoring any of the activities.

## Visual Safety Tests—*American Welding*

Because the American Welding and Manufacturing Company, Warren, Ohio, believes that both the safety and the production rate of a welding operator depend upon his eyes, the company is testing the eyes of all plant employees every six months, free of charge. From 60 to 70 percent need minor vision correctives. About 10 percent have serious eye deficiencies.

Visual safety tests are applied for color discrimination, an important factor in a trade where the relation of color to correct metal heat is direct. Visual acuity, vertical and lateral imbalance, depth perception, ametropia, and near-point fusion are other qualities tested for the workman's visual safety, by means of a special machine.

Conditions of near- or farsightedness, astigmatism, and color blindness are revealed by these tests, and prescriptions for corrective glasses are available without charge. Similarly, prescriptions for correct lenses in safety goggles are based on examinations furnished free by the company at the workman's request.

## Enforcement of Safety Rules—*Ford*

The safety departments at Ford Motor Company plants are organized and operated to anticipate accidents and health hazards before they occur. Each employee is given pamphlets outlining possible hazards from his particular job unless the right safety precautions are taken.

Adherence to safety rules is mandatory; an entire job can be stopped by the safety department if one worker is found violating one of the safety rules, such as failure to wear goggles or operating machinery without the proper safety guard.

Every worker who operates a machine where a bad heart condition or poor vision or hearing would endanger either his safety or that of his fellow-workers, must pass a test and get a certificate guaranteeing that he is suitable for the job.

## Safety Training That Never Ends—*Caterpillar Tractor*

Despite greater production, longer hours, and the employment of older and inexperienced men, handicapped persons, and women new to industrial work, a never-ending program of safety education at Caterpillar Tractor Company, Peoria, Ill., has kept lost-time accidents close to the vanishing point. The program is carried out with the help of plant supervisors who are instructed in the latest safety methods at monthly conferences. The supervisors, in turn, train employees.

The use of protective devices for machinery, and of personal protective equipment like goggles and safety shoes, also plays a big part in the company safety record. All equipment is checked regularly by the safety and sanitation division, and all items except safety shoes are furnished free.

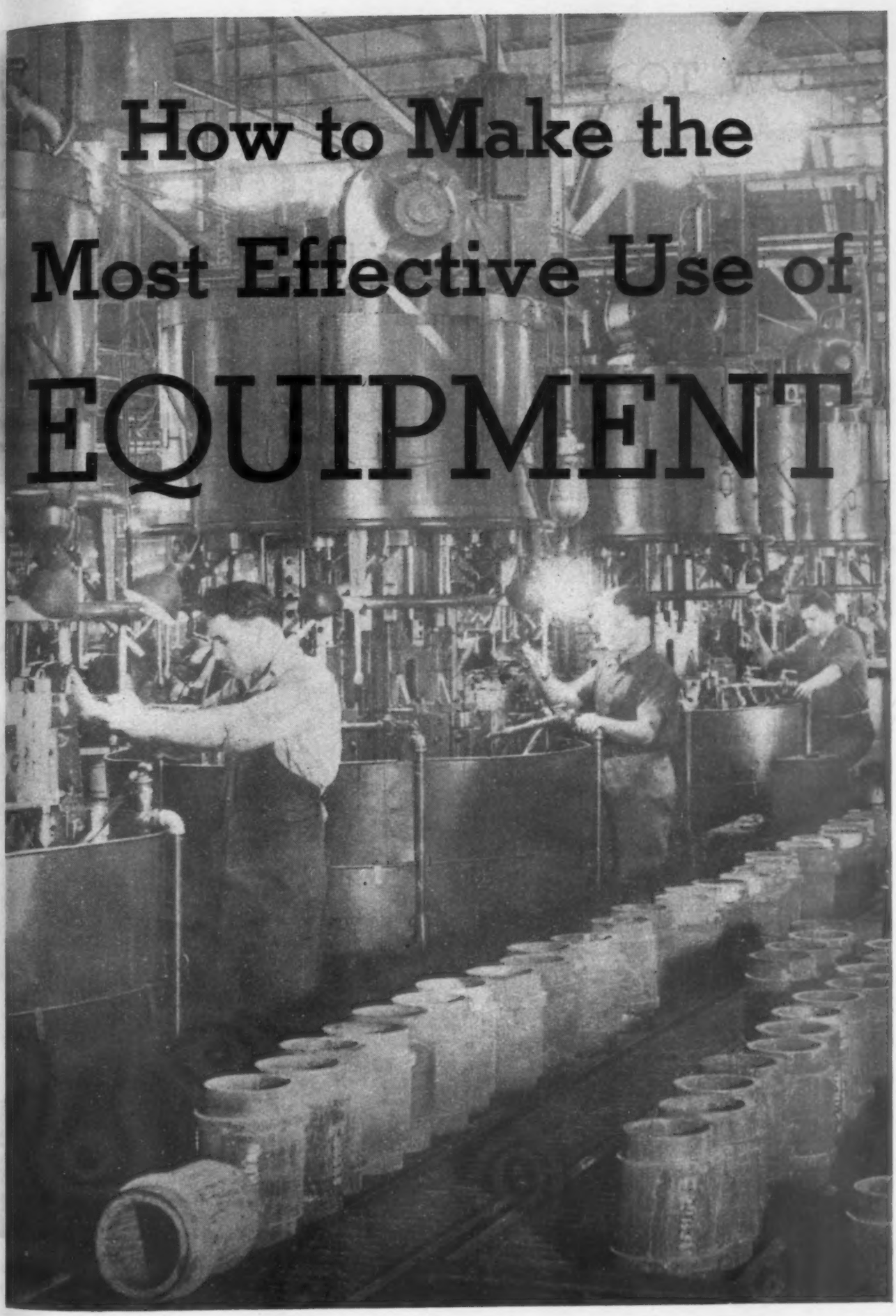
The safety and sanitation division also controls chemical substances used in the plant so that no toxic conditions are present. Air samples are taken and checked in a laboratory maintained for that purpose. A close watch is kept on drinking water and general sanitation.

## Optician on Safety Staff—*Consolidated Vultee*

There is a full-time optician on the safety staff at Consolidated Vultee Aircraft Corporation, Nashville. He is responsible for the eye-accident prevention program, and for the control of inventory and use of all types of safety equipment.

Three girl clerks—one on each shift—dispense safety equipment from a central crib and are responsible directly to the optician, who reports to the safety director.

# How to Make the Most Effective Use of EQUIPMENT



# HOW TO MAKE THE MOST EFFECTIV

# STEP 1 Selec Handling

LOW-COST, HIGH-SPEED PRODUCTION depends to a large extent upon good plant layout. Through departments and over the equipment and machines, as they are arranged, flows the work done in the factory. The layout dictates the course of manufacturing operations, and for the time being is fixed. There is no other way to get the work through. If the channels of flow have been planned for the most efficient progression of work, deliveries will come along on scheduled time, and costs of operation will be held down. If not, delays will jam production, and needless expenses will eat into profits.

The importance of good layout of departments and machines lies in the fact that it brings about the following cost-saving advantages. It:

1. Provides definite lines for travel of work.

2. Gives the shortest feasible distance of travel.

3. Reduces the amount and cost of materials handling.

4. Cuts down the over-all time of work-in-process.

**True three-dimensional layouts are made at the Nashville Division of Consolidated Vultee Aircraft Corporation, where members of the planning department use scaled reproductions of each piece of equipment**

# Layout and That Suit Your Product

5. Reduces to a minimum the amount of work-in-process.

6. Decreases the inventory in storerooms and warehouses.

7. Brings about more efficient utilization of labor and equipment.

8. Conserves floor area.

9. Increases the efficiency of mass production.

10. Simplifies work routing.

11. Reduces the labor and cost of production control.

Fortunately, aside from building limitations which sometimes may prevent desirable changes, departments can be moved and equipment rearranged if a study shows that a better plan can be set up. Too many plants neglect such investigations, regarding the arrangement as fixed, or not even seeing that poor layout is a prime cause of inefficient production. It is not only possible but often urgent that changes be made.

The sequence of steps in planning such a layout is as follows:

1. Find out what variety of, and how many, finished products and subassemblies are to be produced over a given period.

2. List materials and parts comprising the products to find out which to make and which to buy.

3. Tabulate the individual kinds of operations necessary to make the parts and to perform the subassembly and assembly operations that produce a finished unit.

4. Determine the sequence of operations necessary in manufacturing and assembly for the best flow of work, and make up process flow charts covering all such operations.

5. Find out what production equipment and plant facilities will be needed, including special facilities.

6. Check on plant and machine capacity for parts to be made, and on subassembly and assembly capacity throughout the plant.

7. Calculate the time intervals between successive operations to see how much banking of work may develop and what storage space at machines may be necessary.

8. See if any hazardous, dust- or fume-producing, odorous, noisy, or otherwise objectionable operations are involved which should be isolated in special sections.

9. Estimate space requirements for production equipment, storage areas at machines, aisles, elevator or stairway approaches, storerooms, tool cribs, shop offices, inspection, and time study departments.

10. Develop the layout of departments, and the arrangement of machines and equipment within departments, according to the general flow charts and the process charts of individual operations, and the surrounding space requirements, using preferably the templet method or small models of machines for accuracy, flexibility, and speed in drawing plans for the flow of work.

11. Recheck proposed layout with manufacturing, time study, motion study, engineering, and other interested departments to remove unsatisfactory arrangements and get the best layout from all viewpoints.

There are two general kinds of

layout—that for the flow type of production where continuous or repetitive operations are carried on, and that for the intermittent type of production where special orders are the main, if not the only, kind of jobs put through.

For the flow type of production, so-called straight-line layout is the most efficient. Since the respective manufacturing lines are devoted to the manufacture and assembly of specific or closely related kinds of standard products, this layout is also known as the unital or "product" layout. An automobile assembly line, and a series of machines arranged to perform a definite sequence of operations for the production of a certain part, are examples of product layout.

Where special orders constitute most of the work in a plant, and products are not standard to any great extent, equipment and machines usually cannot be laid out for straight-line production because there are no main and practically invariable channels through which all jobs flow. Consequently, equipment must be grouped by departments—milling machines together, planers in a separate section, most drilling machines in another place, and other kinds of equipment similarly placed. This plan is known as functional or "process" layout. For each operation on a part, the part must be taken to the department where machines which perform that particular process are located.

## Product Layout

It is evident that certain conditions must exist to make straight-line manufacturing possible:

1. Standard products made continuously or repetitively

2. Preferably some interchangeability of parts among products

3. Sufficient volume to keep production lines fairly busy

4. Prospect of continued customer demand for the products

5. Good departmental layout for continuous flow of work

6. Product layout of equipment, in general, within departments

7. Good equipment balance—machines or units of equipment of approximately equal capacity at each work station

8. Good labor balance—equivalent amount of work performed at each work station

9. Time and motion studies to determine methods and rate of work

10. Efficient control of materials through the processes of procuring, storing, and issuing

11. Maximum economic use of suitable materials handling equipment

12. Elimination of all avoidable inspection of parts or product

13. Well-organized plan of production control—planning, scheduling, dispatching

Some industries almost naturally adopt straight-line production. Among these are cement plants, chemical plants, sugar refineries, flour mills, iron and steel foundries, rolling mills, canneries, tire plants, textile processing plants, and bakeries. There is a necessary sequence of processes in each case, and the logical tendency is to lay the plant out along the normal line of work flow. Straight-lining prevails whether the plant occupies a single-story or a multi-story building, the opportunity to use gravity flow often making it desirable to operate in a multi-story building.

Other industries have adopted straight-line production because they found it an aid, if not a necessity, to efficient operation. Automotive, radio, electric appliance, electric motor, clothing, shoe, furniture manufacturing, and similar mass-production plants were able to avail themselves of the advantages of straight-line methods because of standard products and repetitive orders. The aviation industry did not rise to high production until it adopted straight-line methods. Prior to that step it was *making*, but not *manufacturing*, planes.

Subcontractors taking orders for large quantities of similar kinds of products, or receiving a flow of repeat orders, can advantageously set up product lines for straight-line production, and can change the layout when transferring to a quite different kind of parts. Usually the bugaboo of fear to change is quickly dispelled when a sound study is made of the savings obtainable versus the trouble and cost of rearrangement. Failure to change and save, results from failure to understand the possibilities and make the studies.

Beyond these groups of companies using straight-line production are large numbers of manufacturing plants that have profitably adopted such a layout and methods in part. Some companies make certain standard products in fairly large volume but do considerable special-order work. For the standard products, straight-line production methods in assemblies and in parts manufacture bring about definite increases in production per unit of time and appreciable savings in cost. Perhaps some of the parts used on special-order products can be made on the same product lines as parts for the standard products. Sometimes similar, but separate, product lines can be efficiently and profitably set up for such manufacture.

Still another large group is composed of companies engaged in manufacturing products for which either certain assemblies or certain parts, on which there are continuous or repetitive runs, may be adapted to straight-line production, whereas the rest of the manufacturing may not be suited to such methods. Even here, studies often indicate a considerable reduction in unit cost from straight-line layout and operation. A machine tool or printing machinery company, for example, may turn out gears, shafts, bearings, and other parts on product lines, or, where the assembly operations are somewhat similar in nature although the assembled products differ in certain essentials, the assemblies may be put through on what is practically a production line.

### Advantages

1. Flow of work over definite and direct routes

2. Less materials handling

3. Close coordination of production operations

4. Less total production time

5. Less work-in-process

6. Less floor area occupied per unit of product

7. Less inspection

8. Simplicity of production control, with fewer records, less accounting, and lower clerical costs

### Disadvantages

1. Higher investment in machines because of duplications

2. More machine idleness

3. Supervision likely to be less efficient, because of extent of knowledge required

4. Breakdowns of equipment are serious and a shutdown may result unless another machine can be supplied to the line

## Process Layout

Turning now to the functional or process type of layout, it is evident that it is best adapted to the intermittent manufacture of non-standard products—in other words, to the special-order or job-shop method of production. Under this plan locomo-

**Bell Aircraft conserves manpower and floor space by piping oxygen, acetylene, and hydrogen from an outside storage building to welding stations, each of which formerly required room for three cylinders. Gases inside the plant are now held at comparatively low pressures. Case study on page 151**

tives, railroad cars, steamships, war vessels, special instruments, special machinery, custom-made furniture, and a wide variety of products are made. Even though these products may all be in the same general line, they differ greatly in detail. Many of the industries in this class occupy single-story buildings, sometimes with mezzanine floors or balconies, because the heavy equipment they use must have substantial foundations, and high headroom is needed for traveling cranes.

It is impossible to lay out any product lines of manufacture, first, because the runs will be too short to repay the cost of setting up, operating, and then changing such lines; second, because the runs may never be repeated, at least not soon or in the same manner. Moreover, there is a variety of work going through upon which the equipment must operate. If a product set-up is made for one part or subassembly, the machines will be tied up beyond normal production time; meanwhile other orders, waiting to go on the individual machines in the line, will be steadily falling behind in delivery.

The best that can be done is to see that the departments in such plants are laid out so that the majority of the work travels in the most nearly direct lines and over the shortest distances possible. Not all departments can be located so that the flow of work avoids backtracking or crisscrossing at all points, but backtracking can be minimized.

When the equipment is laid out by process, the individual operations on each part, subassembly, and assembly are scheduled to the various departments or groups of machines according to (1) load already ahead of such equipment and (2) relative urgency of new orders. If experience data and skill in planning enable the assignment of current work to be made in close conformity with possible performance, the various parts will be produced on time, and subassemblies and assemblies will meet scheduled delivery dates, while the machines and equipment will be occupied as fully, at all periods, as current orders provide work.

It will not be possible, however, to bring about the economies of straight-line production, and a much more complicated system of production control will be necessary than under product layout. In fact, separate detailed work orders will be needed for each operation on each part, and for each inspection, and often for each moving of each part to each operation. In the extreme case, the production control department will be expected to know where each part or lot of parts is at practically every hour of the day.

For the process layout, as compared with product layout, the following are the factors:

**Advantages**

1. Lower investment in, and less duplication of, equipment
2. Machines kept busy most of the time
3. High flexibility in getting the work done
4. Supervision likely to be more efficient
5. Breakdowns of equipment not difficult to handle. Work is transferred to another machine

**Disadvantages**

1. More difficulty in routing and handling work
2. Higher handling cost
3. Special attention necessary for the coordination of work

4. Total time of production is greater

5. In many places, large banks of work-in-process pile up, and there is more work in transit between departments

6. Less-compact layout, greater floor area, per unit of product

7. More inspections—one or more in each department

8. More complex production control, more paperwork, more accounting, and higher clerical costs

## Combination Layout

Where straight-line production is not possible in the entire procedure of manufacturing to bring about the greatest economies in making products and the speediest deliveries from final operations, combinations of the straight-line and the process type of layout are highly advisable, with the object of making the maximum possible use of the straight-line methods and product layout. Even where occasional changes in equipment layout may become necessary, the trend toward straight-line procedure should be maintained, if studies indicate that savings can be made in time and cost of production. Possible cases of such combinations have already been explained in this study.

## Materials Handling

Straight-line production offers the greatest possibilities for using materials handling equipment because of the fixed paths over which the work travels. Conveyors of all kinds, elevators, lowerators, transfer mechanisms, pushbutton or interconnection hookups for remote control, and photocell applications for regulation or stopping of systems are applied in a variety of ways throughout industries making products continuously or repetitively.

Overhead traveling cranes, monorail systems, and mobile equipment such as locomotive cranes likewise are extensively employed. Hand labor is invariably the costliest method for handling materials wherever the quantities are sufficient to utilize the major portion of the capacity of a materials handling unit which might be installed. Each installation must be made on the basis of the requirements of the individual case, although there are numerous instances where some certain kind of equipment offers the most economical, or maybe the only possible, solution of the problem.

It is seldom that one kind of handling equipment will answer all requirements in a straight-line production plant. In addition to the kinds of equipment listed above, lift trucks and fork trucks of the electric- or gasoline-driven type, hand lift trucks, tractors and trailers, and other devices for handling loads varying from small weights to 6000 pounds are in general service. Often these mobile units will operate over regular routes and on fixed schedules to serve the needs of manufacturing.

The plant with process layout finds less use than the straight-line production plant for the fixed types of materials handling equipment. It often makes wider application of the industrial truck or the tractor and trailer method of handling because of the many interlacing flow lines in the travel of parts and subassemblies through manufacture, where routes in general are not standardized and quantities per load are often considerably less than in straight-line manufacturing. But many such plants use the larger kinds of materials handling equipment, such as overhead traveling cranes, locomotive cranes, and elevators, for heavy work in special-order production.

* * *

Case studies are appended in the following pages to show how representative companies are making most effective use of equipment through the selection of layout and handling that fit their products.

## Changing From Departmental Manufacture to Line Production—*Wright Aeronautical Corporation*

Prior to 1940, production schedules for aircraft engines at Wright Aeronautical Corporation were such that departmental manufacture, with all the machines of one general type grouped together, offered the most economical means of production. The outbreak of war, however, led to a demand for thousands of engines of a single type, and involved a complete change in methods. This change included the design and installation of many special-purpose machine tools as well as the placing of electro-plating and heat-treating equipment directly in the production line.

Line production is therefore in full operation today in all Wright plants, and covers not only manufacture of individual parts but also preparation of subassemblies and final engine assembly. Subassembly lines vary according to the nature of the work to be done. For some parts plain benches are adequate; for others a combination of bench and roller conveyor gives best results.

The major assembly is built up progressively on a roller conveyor, whereas minor assemblies such as oil pumps and two-speed clutches are progressively assembled on benches so arranged that the operations will terminate exactly opposite the point on the roller conveyor at which the particular parts are required. Other parts, such as ignition harnesses, are assembled on special jigs mounted on casters and guided by a floor rail so as to travel in an elliptical path past the assembly workers. Each subassembly unit is arranged so that it will deliver its product to the point it is needed.

Engine assembly operates on an automatic, reciprocating conveyor which moves the engine assembly stand from station to station at fixed time intervals. Operations have been standardized so that each part or group of parts can be assembled to the engine in the same unit time, thus equalizing the amount of labor performed by each worker. At the discharge end of the line, tractors haul the completed engines to the test cells from which, after test, they are passed to a similar conveyor for progressive tear down.

The establishment of production lines has proved immensely valuable in stepping up output by (1) eliminating departmental bottlenecks, (2) reducing the handling and transfer of parts to an absolute minimum, (3) facilitating production control, and (4) making possible the employment of large numbers of unskilled men and women as single-operation workers.

## Straight-Line Flow of Parts—*Ohio Crankshaft*

Straight-line flow of material characterizes operations at Ohio Crankshaft Company, Cleveland. Rough forgings enter machining lines at one end, finished pieces exit at the other. In the aviation section a new roller conveyor greatly expedites production.

Formerly floor trucks were used to convey the sections of the shaft down the line. They cluttered the aisles, bunched material, put extra effort on the worker, and frequently contributed to misplacement of parts. The conveyor ends these conditions.

Now the line flow is controlled because fast and slow operations are equalized. Parts do not pile up before a given operation. And when the flow

**Line production—in full swing today in all Wright Aeronautical plants—eliminated bottlenecks, cut handling costs, made possible the employment of large numbers of unskilled men and women**

of material stops it is a signal to a foreman that trouble may have developed up the line. Thanks to the conveyor, operators find they enjoy larger production bonuses.

The conveyor parallels the machining lines on both sides of an aisle. It feeds parts from detail lines into semi-finished stores—and out again to assembly. Certain polishing jobs, as well as many inspection operations, are now done on the conveyor.

Care has been exercised in placing machines and conveyor in proper relation to reduce handling distance for the operators. Lifts serve now only to put shafts into machines.

## Conserving Manpower and Space—*Bell Aircraft*

Individual gas cylinders have been replaced in the welding department at Bell Aircraft Corporation by a piping system which carries oxygen, acetylene and hydrogen directly to the individual benches from a separate, fireproof building. The new arrangement conserves both floor space and manpower.

Superior safety factors in the piping system are many. Gases inside the plant proper are held at comparatively low pressures, and one man controls the flow into the plant instead of individual welders having that control.

The gases are carried by color-identified pipes from the separate building, where one man is employed on each shift to keep the "feed" constant, to the welding stations in the fabrication plant. In the gas-welding department alone, approximately 600 square feet of space is conserved in the immediate vicinity of the workbenches. More space is conserved in the storage room, and where gas cutting takes place.

Each welder's station formerly required space for three cylinders. A reserve station with a capacity for ten additional cylinders was also necessary in the welding department. All told, about 550 tanks were always in the plant—either in use or in storage.

The three cylinders at each worker's station had to be changed about once every 24 hours; cylinders had to be transported to and from the storage room, and bookkeeping was necessary to keep a constant check on the itinerary of cylinders traveling to and from the storage room and welding departments, as well as cylinder shipments to and from the plant itself. The man-hours necessary to handle such detail have been sliced by about 85 percent.

Three oxygen trailer trucks, each carrying 10,000 cubic feet of gas, are parked outside the building where the piping system originates. Each carries enough gas for three or four days' consumption. As one trailer empties, the change-over to the second is made automatically. The gas pressure of each trailer is 2400 pounds per square inch. A master valve control unit directs the gas to a regulator where the pressure is reduced to 75 pounds for direct distribution to the lines.

The pressure going into the lines could be as low as 25 pounds, except for the fact that gas cutting is done. Between the master regulator and the distributing point in the oxygen system is a relief valve to handle excessive pressures which might by accident form in the lines.

A generator delivers filtered acetylene gas to the lines at a pressure of 10 pounds, a single charge usually lasting from 36 to 40 hours. Each of the 500-lb. double-rated generators used for acetylene is capable of delivering 1000 cubic feet of gas per hour, the generators also alternating in service.

A double-bank cylinder manifold with ten cylinders on each side provides hydrogen, each side of the manifold alternately in service.

## Product and Process Layout—*Colonial Radio*

Policy in assembly work at Colonial Radio Corporation, Buffalo, has been a straight-line layout for the major assembled units with subassemblies grouped functionally, depending upon the type of operations required. Many advantages are gained by grouping work such as riveting in one section, particularly on small subassembly units; operators become specialists in a short time, and set-ups are under the control of selected mechanics.

Straight-line production was so set up that inspection operations followed

in natural sequence—to avoid excessive transportation. Wherever it was necessary to transport from one building to another, overhead conveyors were installed. A chart was worked out prior to any conveyor installation to assure its value and necessity. In some instances it was definitely proved that the conveyor would add to the total handling rather than facilitate production. This occurred when it was necessary to remove from the conveyor to a storage bay, or *vice versa*. Colonial also discovered that conveyors are often useful as an adjunct to storage capacity, because several hundred parts in transportation on the conveyor ready for instant use eliminate the necessity for storage.

Length of main assembly lines was standardized so that each of the several lines employed the same number of operators. This plan allows considerable flexibility when shifting from one type of assembly to another, because the company found that a group once set up is more efficient if the same operators are retained.

## Utilization of "Air Rights"—*Allis-Chalmers*

Even with careful planning of new factory layouts, unpredictable wartime expansion may easily outstrip available floor space. For this reason, says Allis-Chalmers Manufacturing Company, Milwaukee, any equipment or arrangement of equipment that literally creates space where none existed before becomes highly valuable.

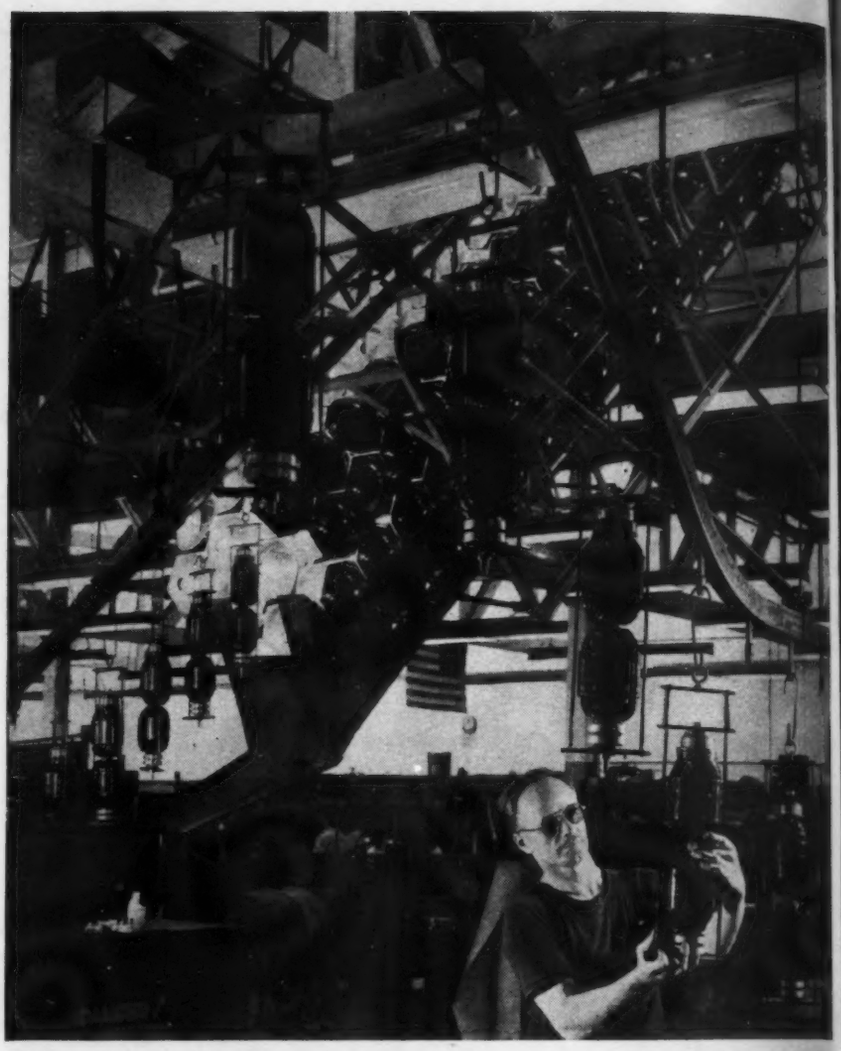
This space factor became a specific problem recently at an Allis-Chalmers plant making vital electrical equipment. The need for setting up a continuous process for insulating and drying inverter armatures was difficult to supply, because the only available space near the armature assembly line was in a busy aisle.

The process of insulating armatures includes preheating, to drive out moisture and close the pores; cooling in an open spot; running armatures through a bath of insulating varnish; and baking them to cure the varnish. Finally, the armatures have to be cooled again.

Infra-red lamps were selected to provide the baking and drying facilities, and they were arranged in two "tunnels." A continuous conveyor carries the armatures from the edge of the cooling section and into the varnish tank, where they are dipped as they move along.

At this point in the layout, about 365 square feet of space was saved by running the conveyor and infra-red equipment to a platform about 15½ feet above floor level. Thus the major portion of the equipment is actually located on a second level above aisle space in a room where a relatively high ceiling not only permits this arrangement, but also eliminates any interference with light or air.

To complete the efficient layout, the conveyor returns to the same point where the raw armatures are originally hooked on—adjacent to the armature assembly floor. For the entire process, only one operator is required, to hook on and remove the armatures. And, to obtain an excellent insulating bake, only 4 hours and 15 minutes are necessary—a definite saving in drying time.



**When Allis-Chalmers set up a continuous insulating and drying process, it literally created space by placing infra-red equipment on a platform 15½ feet off the floor, and running a conveyor up to it**

## Storage on Trailers—*Cooper-Bessemer*

When output was practically doubled at the Mount Vernon, Ohio, plant of The Cooper-Bessemer Corporation, foundry workmen were cramped for space to store engine castings.

To relieve this condition, some of the flasks and castings were placed on old flat cars and moved out of the foundry to rail sidings for the necessary period of gradual cooling. When this expedient failed to solve the problem entirely, low flat platforms were constructed from scrapped steel and discarded parts, with two heavy wooden wheels added to permit easy portability.

Castings weighing up to 16 tons are now placed on these improvised trailers and moved about at will by simply coupling a trailer to one of the shop's electric-powered utility trucks. The loaded trailers are usually parked in the yards outside the plant for cooling or for temporary storage. The same method is also used to save time in transporting the castings to and from the shipping and painting departments which are located in a separate building.

## Economical Switching—*Wickwire Brothers*

In December, 1941, Wickwire Brothers, Inc., Cortland, N. Y., obtained a 25-ton diesel-electric locomotive for general yard duty, to replace an old 70-ton steamer. It has turned out to be one of the best investments in plant equipment this firm ever made, according to Charles C. Wickwire, president, and saved a large part of its purchase price in the first 18 months. Savings were made principally in fuel costs, track maintenance, repairs, and crew expense.

The plant covers 35 acres and has approximately 5 miles of track, mostly curves. The work consists of switching about 60 outgoing and incoming cars per week of coal, steel, slag, and scrap, in addition to the movement of about 450 charging buggies.

Previously a 50-ton and a 70-ton steam locomotive were used. Now the entire job is done with the 25-ton diesel-electric, which operates 24 hours a day, six days a week. It handles general switching during the day and serves the open hearth night and day.

The most noteworthy saving is in fuel costs. The diesel-electric used 1683 gallons of fuel oil in a 3-month period, or about $2.25 per 24-hour day, using the best fuel oil obtainable. The steamers used 14 tons of $5 coal per week. This is a saving of about $9.50 a day on fuel.

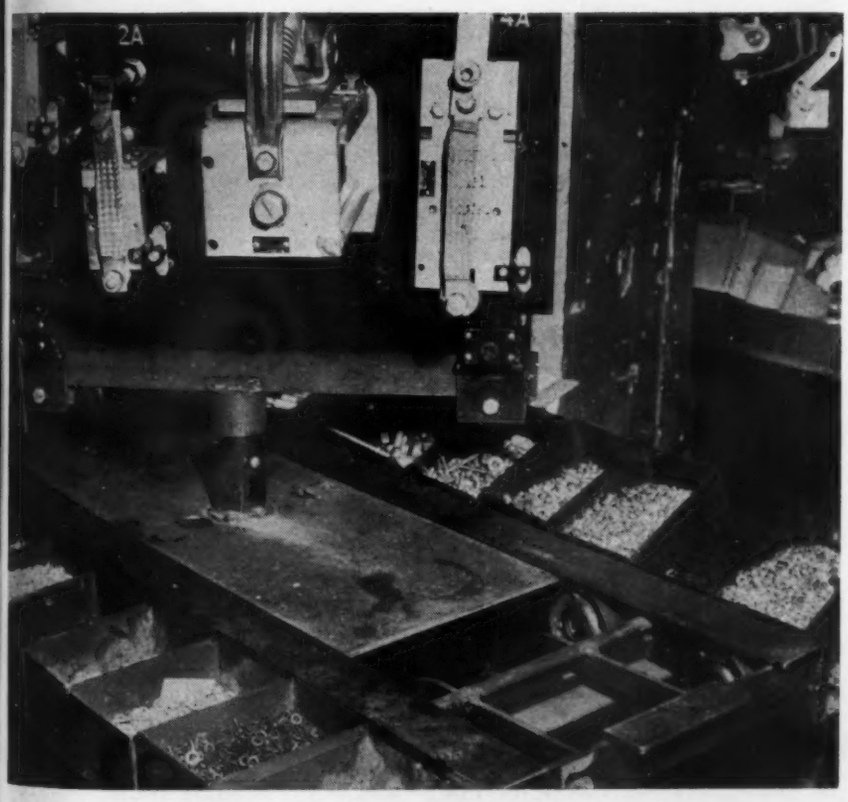
Large savings were made in labor. The diesel-electric requires only one man to operate it. The steamers required both an engineer and a fireman. Perhaps more important than reduced operating costs, it is estimated that the diesel-electric made roughly 2500 extra man-hours per year available for use elsewhere in the plant.

## Assembly on Pallets—*General Electric*

An assembly and test set-up at the Schenectady Works of General Electric Company utilizes pallets which are moved on an inverted roller conveyor, and is responsible for a 500 per cent improvement in per-unit production time of control panels. Moreover, the new set-up permits handling much greater output in essentially the same floor space required by the old method.

Previously, the panel bases were held in stationary vises on pipe racks for assembly and wiring. Then they had to be moved on wheeled skids.

Under the new arrangement, the panel bases are locked in a swivel-mounted vise arm on individual pallets. Pallets are easily pushed along the inverted roller conveyor or transferred from one section of it to another. Panel bases remain on the pallets through the successive steps of assembly, wiring, and test.



**Pallets that move on an inverted roller conveyor simplify assembly of panel bases at General Electric. Units are locked in a swivel-mounted vise arm, can be turned to suit assembler's convenience**

## Overhead Conveyor for Parts—*Bell Aircraft*

Final assembly of Airacobras at Bell Aircraft Corporation is accomplished on constant-motion conveyor lines, and production is geared to a schedule which requires parts to be at a specific assembly station at the precise moment they are needed. The problem is to get parts from the stockroom to the assembly floor on a split-second schedule. It is achieved by carrying the parts out over a ramp which runs along one side of the big assembly building at a position close to the ceiling.

Six catwalks extend from the ramp across the top of the building, high above the assembly floor. Complete sets of parts to be assembled in one warplane at a particular station are made up as kits in the master stockroom, which is located at the far end of the building. Several such kits for a like number of stations are then placed in conveyor carrier and sent over the ramp past the catwalks. Destinations are plainly marked on the baskets.

As an appropriately identified carrier goes past the catwalk nearest to the assembly station for which it is marked, a production control representative picks the kits off and places them in a bank for which she is responsible. When a specific kit is needed at a specific station, she moves one from her bank along a monorail that runs parallel to the catwalk to which she is assigned. As the part moves over the station for which it is designated, she lowers it to the assembly floor. A square more than big enough to hold a basket is painted on the floor at each station, and kept clear.

There are four types of conveyors in the assembly plant. Most conspicuous of all are the constantly moving lines that carry baskets of parts. Second is the monorail which is used to lift heavy assemblies into place. The third overhead conveyor system is a crane which teams with the monorail in handling exceptionally heavy parts. Fourth is a 5-ton crane which runs down the final assembly line and lifts completed planes up and over other planes in the same line to a position at the exit of the assembly building.

# HOW TO MAKE THE MOST EFFECTIVE

## STEP 2

# Find the One Way of M

CALL IT WHAT YOU WILL, finding the "one best way" of manufacture nets down to discovering how to do each job of work with most economical use of manpower and equipment in relation to time. Usually the best way is the simplest way, which means that revisions of manufacturing methods looking toward increased efficiency are almost bound to involve simplification of method, equipment, and layout. For our purposes here, therefore, we are using the term "work simplification" to describe those procedures ordinarily followed in determining the one best way of manufacture.

Work simplification is a broad term used to describe a program of training whereby a group of people are taught certain principles and techniques which they then apply to their own jobs in order to reduce waste of manpower, materials, and machine capacity. The principles and techniques included in a typical work simplification program range all the way from a formula for increasing personal efficiency to the use of a rough analysis form for listing the steps in a process, or to the use of a detailed analysis procedure involving the use of motion pictures for studying a particular operation.

Since work simplification is a broad, over-all term, and because it includes a variety of techniques, it is readily understandable that some people have failed to interpret it correctly. In their thinking, they have narrowed the meaning of work simplification to include only that phase of it which applies to the detailed analysis and improvement of hand operations. This misconception has, no doubt, been fostered by the fact that many of the articles published about work simplification programs have included descriptions and photographs of small hand-assembly jobs in order to show how certain principles were applied.

In the same way, many of the moving pictures of work simplification improvements that have been exhibited at various management and engineering society meetings, have shown *before* and *after* methods on individual assembly or inspection jobs. In both cases, the reason for using short-cycle bench-assembly jobs as an illustration was that they are much easier to photograph and describe than would be a complete process involving changes in layout, design of equipment, or handling methods. It should be clearly kept in mind that these examples were included as a means of illustrating the use of basic principles and techniques, and should not be interpreted as indicating the scope of application for work simplification.

### An Unlimited Field

It is not an exaggeration to say that the field for work simplification is unlimited. It can be used in any department of any industry. It can be used in agriculture, in transportation, in schools and homes, or on a battleship—wherever there is activity.

A few examples will serve to indicate the scope and variety of ways in which it may be employed. In a large airplane factory that applied work simplification to some of its office procedures, filing operations in the credit and billing sections were reduced 33 percent, and 24 drawers and 6 file cabinets formerly needed were eliminated. Some 2000 hours per year of messenger time was saved by moving 4 clerks from the central office to the department where their

SE OF EQUIPMENT

# One Best Manufacture

**Slanted table—an employee suggestion—adds to ease of drilling operation, reduces worker fatigue at Vega. Case study on page 159**

work originated. An analysis of the requirements for spare parts invoice copies showed that it was possible to reduce the number of copies prepared by 57 percent. This meant that over 1,500,000 printed forms per year no longer had to be duplicated, collated, distributed, and filed!

In an article (FACTORY, August, 1942) describing RCA Manufacturing Company's use of motion study principles, the author states:

"A revolutionary method of packing radio receiving tubes has been developed by RCA as part of its work simplification program. Resulting savings run as high as 300 percent in critical shipping space, 30 percent in material requirements, and 20 percent in labor needed for testing, branding, handling, and warehousing. Over-all savings in material and time are being made for all types of tubes at the rate of $60,000 annually, of which $24,000 represents saving in receiving-tube packaging."

Another company engaged in the manufacture of motive-equipment parts for naval craft found that by changing the design of a shaft, so that the necessity for cutting a tapered thread was eliminated, it could be

machined in one-fourth of the time previously required.

Many more cases could be cited to show the variety of activities in which work simplification has been applied successfully; but the foregoing are sufficient to demonstrate that production can be increased and manpower utilized more effectively wherever a work simplification program is initiated and properly conducted.

The first requirement for a successful work simplification program is that the executive management of the company be completely sold on the desirability of starting it. Work simplification is, in a sense, creative in that it seeks to discover and develop new ways of doing things. Because of this it will necessarily upset some preconceived ideas as to how certain things should be done. Unless the top-ranking executives in the organization really want progress and believe in work simplification as a device for finding better ways, they are apt to stand in the path of the improvements that can result from a program of this kind. It is not enough that they think work simplification would be a good thing. They must actively and enthusiastically support the program.

Once top management has decided to embark on a training program of this type, the first question that must be decided is where the work simplification department shall be set up in the organization. There are two points of view, from an organization standpoint, as to where this activity may be best fitted in. One school of thought believes that, because work simplification is essentially a training activity, it logically belongs as a function of the training department. The other school believes that, since work simplification is training in the fundamentals of industrial engineering, it should be set up as a function of the industrial engineering department. Experience indicates that either set-up will work satisfactorily.

## Choosing the Leader

The next step in organizing the program is to select the individual who will head the program and carry on the training. In considering the qualifications that this individual should have, there are two or three fundamentals which should not be overlooked. In the first place, it is important to select a person with the right type of personality. He will be involved in many human relations situations, not only in acting as leader of the groups which he is training, but also in working with them individually in helping to introduce the changes that their analyses have shown to be desirable. This man must be an individual who gets along well with others, if the training is to be effective.

Other things to consider are his educational background and experience. While it is probably not necessary that the candidate be a college graduate, he should at least have the mental viewpoint and the intelligence that college training typifies. Both an engineering background and a knowledge of shop operations are desirable, as well as a sense of humor. Careful consideration should be given to the problem of selecting the proper man for this job. He needs to be good!

## Training the Leader

The next step is to provide the necessary training for the individual who is to carry on the work simplification program.

One method is to have this man attend a course designed specifically to provide the necessary training for carrying on work simplification. Training programs of this type are run by some of the universities during the summer, and also by industrial consultants in this field. These courses usually include detailed instruction in the techniques of work simplification, combined with actual laboratory practice in applying these principles to a project brought from the individual's own company. (Frequently, the tuition cost is more than recovered as a result of the improvement made.) There is also instruction in taking moving pictures and splicing and editing film, and in using both silent and sound projectors, as well as a course in public speaking designed to help the individual acquire the ability to think on his feet and speak in front of a group.

In addition, there is generally included a series of talks by well-known people in the fields of motion study, labor relations, practical psychology, and principles of management. The delegate attending a course of this sort is provided with a full set of notes and an outline of material to be used in conducting sessions with groups at his own plant.

An individual can also receive training by attending university courses dealing primarily with the principles of work simplification. These, too, offer practical laboratory work.

Another way in which a program may be initiated is to have an outside consultant come in and conduct the first complete series of work simplification meetings. The company man works with this outside consultant and in so doing acquires sufficient familiarity with the content and techniques to be able to carry on after the first program is completed.

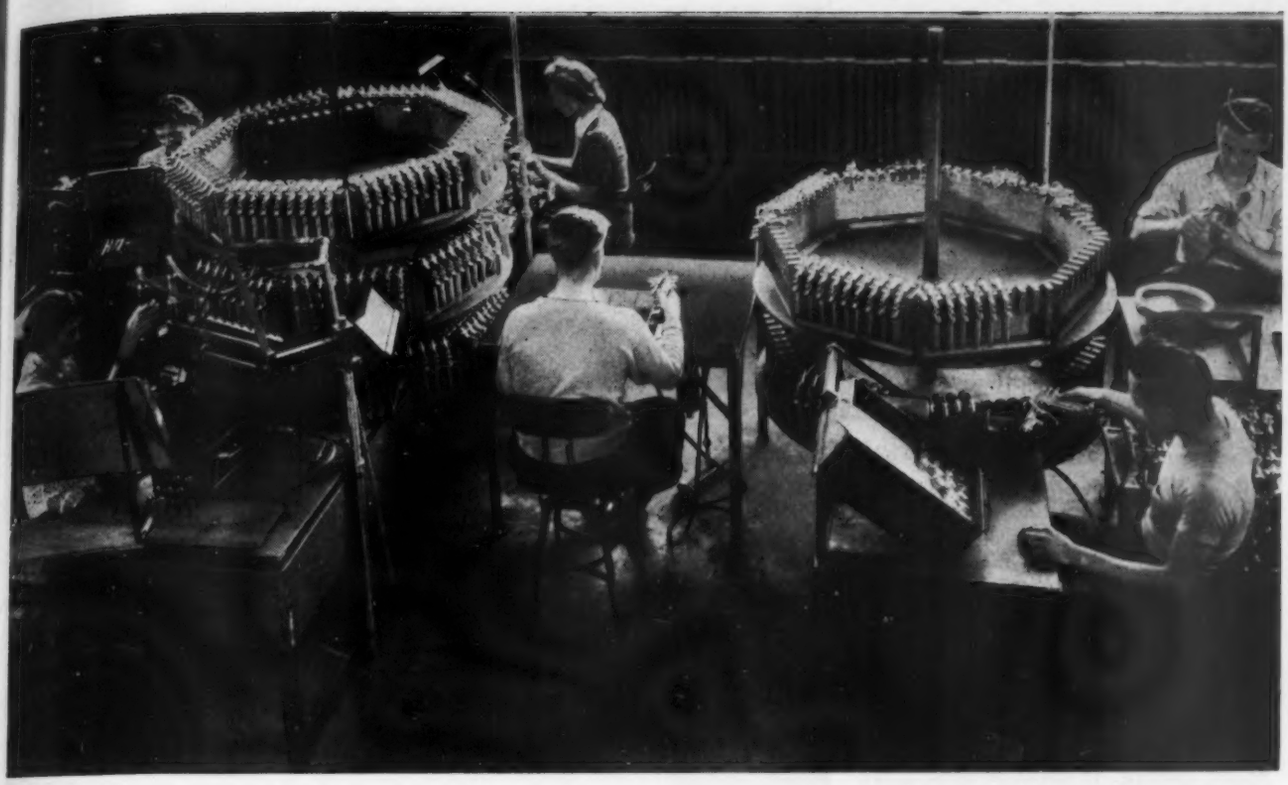
The Training Within-Industry Division of the War Manpower Commission has a program known as Job Methods Training, which, while not nearly so detailed and complete as the formal work simplification program, nevertheless is aimed at the same objective. Having the man who is to head work simplification attend the Job Methods Training Institute helps to give him a background in this same field; and the JMT program as set up can well be used either as an introduction to, or follow-up for, the more complete work simplification program.

After the work simplification man has received training that will enable him to carry on a program, it is necessary to provide certain required equipment. First of all, there should be made available a room where the meetings may be held. While this room does not need to be fancy, it should be reasonably free from outside noises, well lighted, properly ventilated, and equipped with a good blackboard. The room contains either a conference table and comfortable chairs, or chairs with table-top arms, as it will be necessary for the men to do a certain amount of writing during some of the meetings. A camera, projector, and screen also are required, as much of the instruction is carried on by the use of both silent and sound slide films. Each company will want to build up a library of its own films, as well as rent special ones from time to time. Notebooks, mimeographed notes, forms for use in analyzing methods, and reprints of suitable material also are provided.

## Providing Assistance

In order that the program may be fully successful, it is desirable to set up a mechanism for providing assistance in the following lines: First, some type of methods engineering assistance should be available so that when individuals bring in proposals requiring considerable engineering study they may be given help. Incidentally, one advantage of setting up the work simplification program as part of the industrial engineering activity is that the man heading the work simplification program can call on methods engineers in the department to assist in investigating proposals brought in by people receiving the work simplification training.

Another way to make the program more effective is to provide assistance in fabricating and constructing equipment, incorporating new ideas and



**Two turntables, at which six assemblers sit, save time and space at DeVilbiss Company. The old method required 6½ operators for 30 spray guns per hour; new calls for 5¾ operators for 60 guns. Turntables permit handling of individual assemblies instead of racks of guns. Case study on page 163**

changes. It is difficult, under present-day pressures, to carry out through regular channels of engineering and maintenance the ideas and suggestions that come in from members of the work simplification classes. And, since each person who brings in an improvement likes to see it tried out as soon as possible, it is helpful to have one or two good all-around mechanics, who work full-time under the direction of the work simplification head and who are available to try out these ideas.

There is one other mechanism that many companies have found useful in contributing to the success of their work simplification programs, and that is a suggestion plan. During the early stages of the program, when it is being given mainly to people in supervisory and executive positions, a suggestion plan may not be required in order to maintain continued interest in making improvements, but as the program continues into its second and third years, and is extended to the lower supervisory levels or to the key operator level, it becomes increasingly desirable to provide some plan whereby a person may be rewarded in proportion to the excellence of the improvement he has worked out. The suggestion plan, to be used, does not need to be elaborate. It should be set up fairly and each suggestion must be equitably rewarded. Details of the plan should be published so that all members of an organization may know how the system operates; and the plan should be capably administered and maintained. If these few fundamentals are adhered to, the plan will work well, and do much to stimulate a continuing interest in improvements.

## Outline of Program in Fifteen Sessions

A typical work simplification program contains anywhere from 10 to 20 sessions. The outline that follows briefly describes the content of a program covering 15 meetings:

**Session 1: Introduction.** This first session serves to introduce the topic of work simplification and define its objectives. It also points out that a program of this type is bound to meet with much mental resistance in that it is natural for all of us to resist change, and we are all sensitive to any criticism that may be implied through recommending that a method we are using could be improved by making certain changes. The value of maintaining an open-minded attitude is emphasized. A moving picture is shown of typical work simplification improvements in other companies, and the thought is developed that *it can be done here, too!*

**Session 2: Progress.** The economic reasons for progress are discussed, and it is pointed out that any company must make changes from time to time in its methods and products if it is to stay in business. It is emphatically stressed that the work simplification program is not designed to speed up the actions of an individual employee, but rather to eliminate the wasteful and unnecessary parts of his job so that his productivity is increased with the same or less effort on his part.

**Session 3: Flow Process Chart Construction.** This meeting is devoted entirely to instruction and practice in making a flow process chart. A flow process chart is a detailed record indicating the sequence of steps in any process. The ability to use this device with facility will help any person spot wasteful or unnecessary steps in a process.

The members of the group are asked to bring to the next meeting charts of some everyday job they do at home, such as "banking the furnace for the night," "getting dressed," etc. A typical movie is shown.

**Session 4: Flow Process Chart Analysis.** The improvement principles ap-

plying to flow process charts are taken up. The questions *who, why, what, where, when,* and *how,* are asked of every symbol shown on the chart. This searching analysis and questioning of the existing methods suggests many possibilities for improvement and helps to eliminate many of the wasteful and unnecessary parts of the work which add no value to the product. Each member is asked to make a process chart of some operation in his own department. Movies illustrating typical process improvements are shown at this meeting.

**Session 5: Flow Process Chart Analysis (continued).** The technique of analyzing a process that has been set down on a flow chart is further discussed. It is pointed out that each step listed on the chart is investigated to see (1) whether it can be eliminated; (2) whether it could be combined with some other step in the process; or (3) whether there is an advantage in having a particular step take place at some earlier or later part of the process. If none of these three things can be done, the operation is examined to see how it can be made less complex.

Movies are shown of jobs that have been improved by eliminating, combining, changing the sequence of, or simplifying, certain steps in the process. The group members are asked to apply these four devices to the flow charts they have drawn up.

**Session 6: Analyzing the Method for Improvement.** This is a continuation of Session 5 with additional instruction in methods of eliminating backtracking, rehandling, etc., by the use of flow diagrams. "Before and after" movies are shown to illustrate the type of operations that are subject to improvement through flow process chart analysis procedure, and a representative job is analyzed.

**Session 7: Importance of Time.** This session stresses the importance of planning and scheduling work so that time is not wasted. It is pointed out that, in the rush of industrial activity, many supervisors find themselves in the position of jumping from one thing to another without getting any one thing properly completed. The fundamental principles to be followed in scheduling time are discussed, and each member of the group is asked to draw up a schedule of things to be done and plan the time for doing them most effectively.

**Session 8: Man-and-Machine Chart Construction.** Man-and-machine charts are one tool of work simplification that is sure to find universal application in analyzing operations in industry. A man-and-machine chart is a graphic analysis of the relationship, on a time scale, between a man and the machine he is operating.

This session is devoted entirely to instruction in making charts of this type. A convenient demonstration to use in teaching how a man-and-machine chart is constructed, is the operation of setting up, projecting, and rewinding a movie film.

The members of the group are requested to make a man-and-machine analysis of one of the operations in their department.

**Session 9: Man-and-Machine Chart Analysis and Improvement.** The improvement principles applying to man-and-machine charts are discussed. Typical man-and-machine operations are analyzed, and the various methods of increasing the productivity of both the man and the machine are pointed out. One principle frequently found to be violated is that, while the machine is stopped, the man is doing work that should be done while the machine is in operation. Frequently, the productivity of a machine can be increased considerably by rearranging the man's work so that all possible elements of the job are done during the machine cycle.

Moving pictures are shown of "before and after" methods on representative man and machine jobs.

**Session 10: Fundamentals of Hand Motions.** The objective of this session is to develop motion consciousness in the men's thinking. To accomplish this, the following motion economy rules are illustrated and discussed:

1. Always use the lowest-class motions possible.

2. Locate tools and materials within the normal working area.

3. Don't have holding done by the hands—use jigs and fixtures.

4. Pre-position tools and supplies, and use drop deliveries whenever it is possible to do so.

5. Motions of the arms should be made in opposite and symmetrical directions simultaneously.

6. Wherever practical, use foot operated devices and leave the hands free for other useful work.

A knowledge of these fundamentals helps the men to recognize wasteful and fatiguing motions, and guides them in rearranging the workplace so that a minimum of motions are required, thereby reducing fatigue and increasing productivity.

**Driller on wing tips at Murray used to work in pairs. One girl drilled; the other held wood block against skin to stop buckling. New method on opposite page**

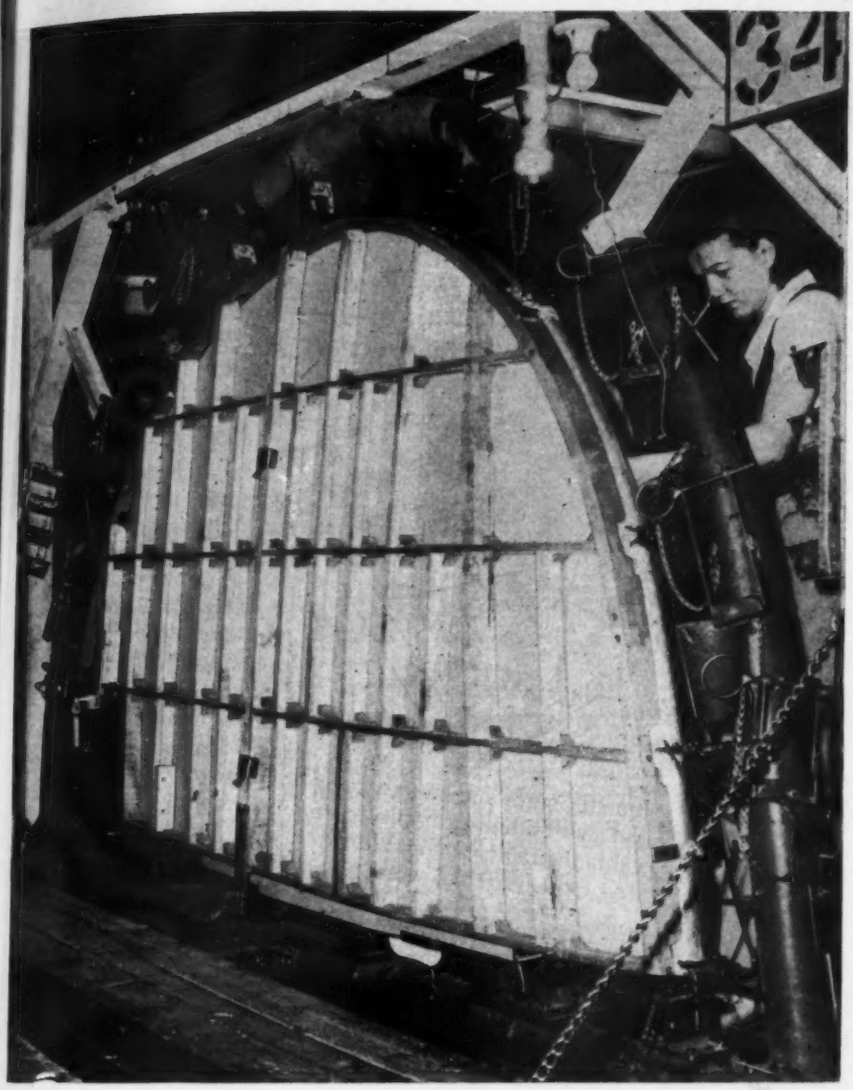
**Session 11: Right-and-Left-Hand Chart Construction.** The technique of making right-and-left-hand charts is discussed. This type of chart is used for analyzing short-cycle highly repetitive jobs that involve hand operations. These charts are also effective for use in training new employees on a job, as they list the detailed movements of each hand in sequence.

An assignment is given to the members of the group to make a right-and-left-hand chart of an operation.

**Session 12: Right-and-Left-Hand Chart Analysis.** This session is devoted to a discussion of how the six principles in the Session 10 may be applied to the improvement of operations that have been charted on right-and-left-hand charts. Moving pictures are used to illustrate typical right-and-left-hand operation improvements.

**Session 13: Value of Clean and Orderly Workplaces.** The emphasis here is on the importance of maintaining clean and orderly working areas. It is pointed out that both cleanliness and order have a direct bearing on the efficiency of operations. Moving pictures are shown to illustrate the congestion and waste resulting from disorderly conditions.

The basic idea put across in this session is that disorderliness prevents efficient operation. Henry Ford expressed this same thought when he said, "No business I know of ever went to the wall without first accumu-



**Back-up boards replace girls who held wood blocks for drillers, save an estimated 31,500 man-hours at Murray Corporation. The board holds the assembly tight, insures perfect fit of overlapping skins**

lating a vast pile of dirt. The dirt and all that goes with it—untidy thinking and methods—helped to cause the failure."

**Session 14: Material Conservation.** Since material frequently represents a larger part of the cost of a product than the labor does, this session is included. It is entirely devoted to methods of eliminating waste of material. It is shown how a process chart analysis can be applied to material use from a quantitative standpoint. The common ways in which material is lost or spoiled are pointed out, and the fundamental steps to take in preventing waste are discussed.

It is noteworthy that this technique can be effectively used to uncover many possibilities for substantial savings in following paper forms, bulletins, etc., through their sequence of operations. Members are asked to make a material flow process chart of some operation under their supervision.

**Session 15: Review and Summary.** The final meeting is used to review the techniques that have been presented, and to show how they all tie together to provide a kit of tools that can be used to analyze and improve any operation.

Moving pictures are shown of representative jobs that have been improved by members of the group during the series of meetings.

The session is closed on the keynote that every existing method in each man's department offers an opportunity for improvement because "there's always a better way."

* * *

In these days of all-out production for our very existence, every company faced with a shortage of manpower, machine capacity, or material would do well to consider work simplification as an aid to solving its problems. While it is true that work simplification cannot accomplish the impossible, it is also true that a properly organized and conducted work simplification program can do much in helping industrial plant management to get the most from available manpower and equipment.

How selected companies are using work simplification to attain that objective is illustrated in the case examples that follow.

## Ideas From Workers—*Murray Corporation*

Nine suggestions translated into production short cuts, picked pretty much at random from a list of hundreds received at Murray Corporation of America, Detroit, reveal savings believed to total the amazing amount of 200,000 man-hours.

Typical is one worker's idea, which called for the use of "back-up" boards, and resulted in releasing an estimated 31,500 man-hours for other vital work. Formerly an extra worker had to hold a 2x4 against wing tip skins during a drilling operation, to keep the skin from buckling. The back-up board halved the force required. It holds the skins tight, producing perfect fit of the two overlapping skins.

Requiring three hours and $40 to install, a floor and work station rearrangement in the Flying Fortress nacelle beam assembly utilizes automotive techniques. Each workman's operation is specialized, thus releasing an estimated 48,100 man-hour in this one department. The same principle was used on an adjoining operation, effecting savings calculated at 39,251 man-hours.

## Clearing House for Suggestions—*Lockheed*

A work simplification department has been set up at Lockheed and Vega which, in addition to its own assignment to design ways and means of cutting corners to speed production, serves as a clearing house for ideas submitted by workers.

Employees are urged to submit their ideas if they (1) increase production; (2) reduce production cost or time; (3) eliminate or reduce hazards; (4) improve existing methods, either in the factory or in the office; (5) eliminate or reduce waste of time, materials, tools, or energy; (6) improve protection of property; (7) improve quality

of company products; (8) propose a new product that can be manufactured with present equipment and facilities.

For improvements resulting in measurable savings, cash awards are based on 10 percent of estimated net savings for one year, up to an established maximum award of $500. At the discretion of the company presidents, an exceptional improvement may be considered for a larger award. The minimum award is $2.50.

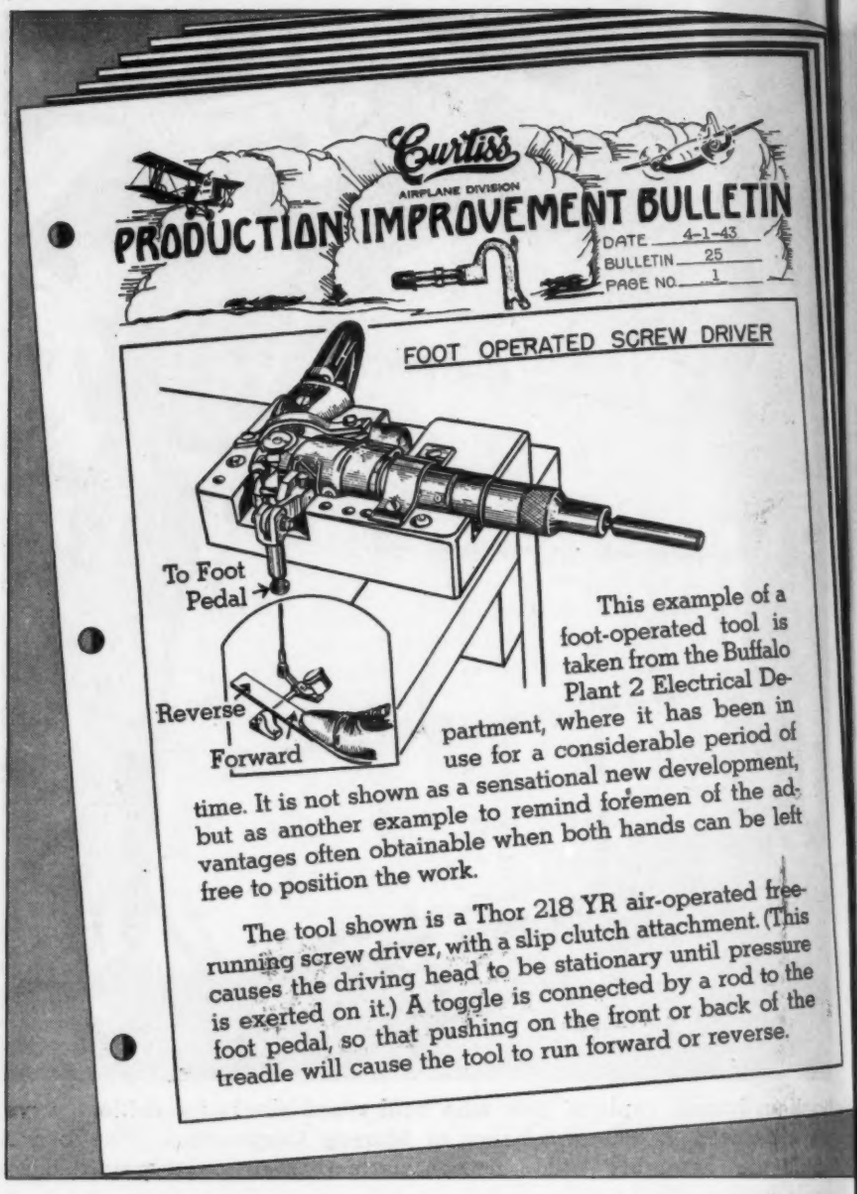
If the company considers the idea of sufficient merit to take patent action, the worker receives $25 when application is filed and another $25 when the patent is issued. If the company grants licenses or makes sales of whole or partial rights under the patent, the employee receives 10 percent of the money for such licensing or sale. The established maximum for such awards is $5000, but in unusual cases the maximum award may be exceeded. This money is in addition to the regular cash award for an acceptable idea.

Ten employees have hit the "jackpot" to date, receiving awards of $400 to $500. Combined suggestions have already saved approximately 380,000 man-hours on an annual basis.

Suggestions have ranged from fabrication and assembly methods to the handling of accounting and inventory. Many involve no more than changes in the sequences of various operations, with increased efficiency. In this class was a suggestion from Harry D. Conger in the Lightning P-38 wing and tail assembly department at Lockheed, which saves about 60,000 man-hours per year in corrugating inner wing stiffeners.

To Charles C. Cooper, a group leader in Vega final assembly, goes credit for overcoming a most difficult operation in the installation of cables in the control stands. The job previously required the services of several men and a considerable number of special tools and fittings. It also required that cables be run into the control stands in the ship, properly marked, removed, and taken into the shop for swaging of wedges. Cables were then taken back to ship, run through firewalls for the hook-up prior to final rig inspection.

Cooper devised a system whereby all cables in the control stand are to be swaged before they are installed. It eliminates the use of all special tools necessary to maintain proper clearance between bracket aft of firewall and bracket on firewall. It makes all cables interchangeable and puts fittings in a better place for service, particularly in the field where special tools and fittings are often hard to get.


Curtiss
AIRPLANE DIVISION
PRODUCTION IMPROVEMENT BULLETIN
DATE 4-1-43
BULLETIN 25
PAGE NO. 1
FOOT OPERATED SCREW DRIVER
To Foot Pedal
Reverse
Forward
This example of a foot-operated tool is taken from the Buffalo Plant 2 Electrical Department, where it has been in use for a considerable period of time. It is not shown as a sensational new development, but as another example to remind foremen of the advantages often obtainable when both hands can be left free to position the work.
The tool shown is a Thor 218 YR air-operated free-running screw driver, with a slip clutch attachment. (This causes the driving head to be stationary until pressure is exerted on it.) A toggle is connected by a rod to the foot pedal, so that pushing on the front or back of the treadle will cause the tool to run forward or reverse.

**Dissemination of information on new methods is not left to chance at Curtiss-Wright plants. Bulletins go to all interested personnel**

## Circulating Short Cut Data—*Curtiss-Wright*

To make sure that information on new methods and manufacturing short cuts reaches the right people, the Curtiss-Wright Corporation's Airplane Division is using what it calls "Production Improvement Bulletins."

These bulletins are sent to all interested personnel, to more than 100 subcontractors, and to almost all aircraft manufacturers. They are marked to indicate the departments concerned, so that busy men are not bothered with irrelevant material.

Tool drawings, reports, or similar specific information are referenced when possible, so that complete details are easy to obtain.

Many of the items issued as bulletins are not new developments, but cover practical methods perhaps unknown to the inexperienced supervisor. There are also "gadget" ideas—such as riveting hints, or a pictured spring stop for portable drills. Bulletins titled "Easily Made Cam Slides for Form Dies," "Use More Dinking Dies to Reduce Handwork," and the like are intended to remind foremen and planners that quantities are becoming large enough to warrant wider use of dies, rolls, and so on.

Bulletins are sent out from Buffalo to an agent in the other plants, who distributes them to assistant general foremen. So much interest has been shown that in five months the number distributed has increased from 300 to well over 1000.

## Increasing Man-Machine Output—*Bigelow-Sanford*

The application of motion study principles materially increased both man and machine productivity on a war job in the machinery division of the Bigelow-Sanford Carpet Company, Thompsonville, Conn.

In the machining and pre-assembly work on castings for machine tools, one operation involved the assembly of a base casting to a column casting. Previous operations on these castings involved planing the bearing and mating surfaces, and drilling the base for connection purposes. Because of the nature of the castings, the method used entailed pre-assembly of the castings for location of holes necessary for assembly. It employed one machine operator and two helpers. The two helpers were assigned the tasks of positioning the castings, disposal of castings, and miscellaneous work; the machine operator drilled, reamed, and counterbored the castings with a radial drill.

A study of the original operation showed the machine efficiency to be low and the labor effectiveness to be equally low. Since the "get ready" portion of the cycle resulted in the low machine efficiency and since the helpers were idle through a large portion of the run time, it was a logical step to absorb these idle times by working on two sets of castings at one time.

The improved method provides for the set-up of two pieces by the helpers. The machine work shifts from one set of castings to the next to attain greater machine productivity.

The improved method has allowed for a 70 percent increase in machine productivity and a 41 percent decrease in man minutes per piece.

## Applying Motion Study to Small Orders—*Scovill*

A recent change in methods at Scovill Manufacturing Company, Waterbury, Conn., is perhaps an answer to the perennial question asked of people who handle work simplification programs: "Can work simplification principles be applied to small orders?"

In this company's press department a great deal of congestion was created by the processing of a rectangular shell, $4\frac{1}{8}$x$4\frac{1}{8}$x$6\frac{3}{4}$ inches. Greatest production on any one lot was 5000 pieces. It was necessary to pack these shells in large wooden cases before and after each of seven operations.

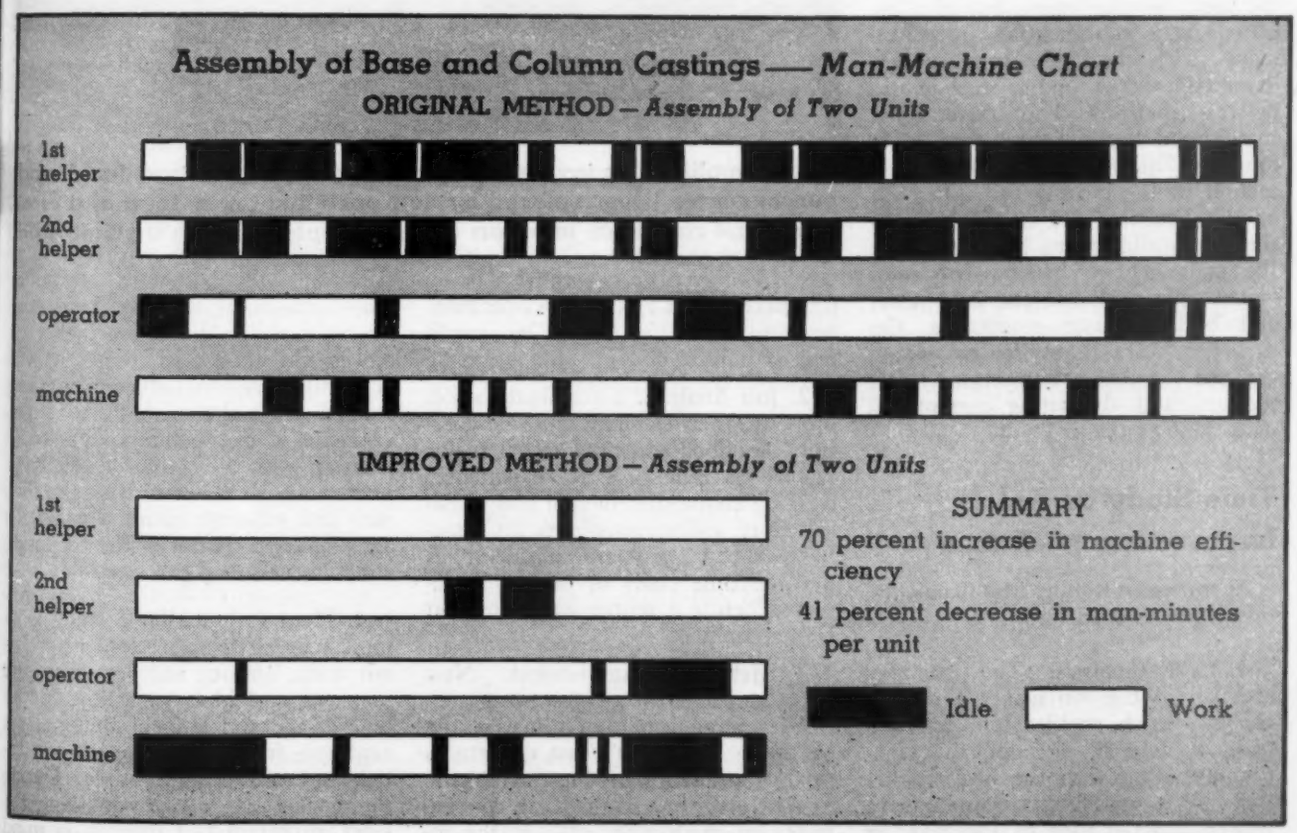
The presses used were in various parts of the room. Material had to be transported between operations. As the operations varied in production per hour, a great deal of floor space was used for storage purposes, so much so that safety rules could not be observed.

Flow process charts indicated that presses should be rearranged for straight-line production. This was done at a cost of approximately $30. Wooden chutes were set up between presses. The sequence of operations was changed so that the higher productive jobs started and ended the flow of work through the press battery, to allow for the extra time for the unpacking and packing elements. Between presses the work was placed in the wooden chutes by the operator and pushed its own width, moving all the shells by that much.

Congestion was eliminated immediately. All toteboxes for intermediate storage between operations became unnecessary, and aisle spaces were cleared as though by magic.

More tangible savings resulted, because of an increase in production made possible by the elimination of unpacking, packing, and waiting for service between operations.

Costs were further reduced by a reduction in service required. Formerly four move-men were used; it




**Analysis of old method at Bigelow-Sanford showed excessive idle time. Logical step was to absorb most of it by working on two sets of castings at one time. Note increase in machine productivity**

is now necessary to use only two. Floor space saved was 150 square feet. Increase in production averaged 75 percent. There was a saving of 50 percent in indirect labor.

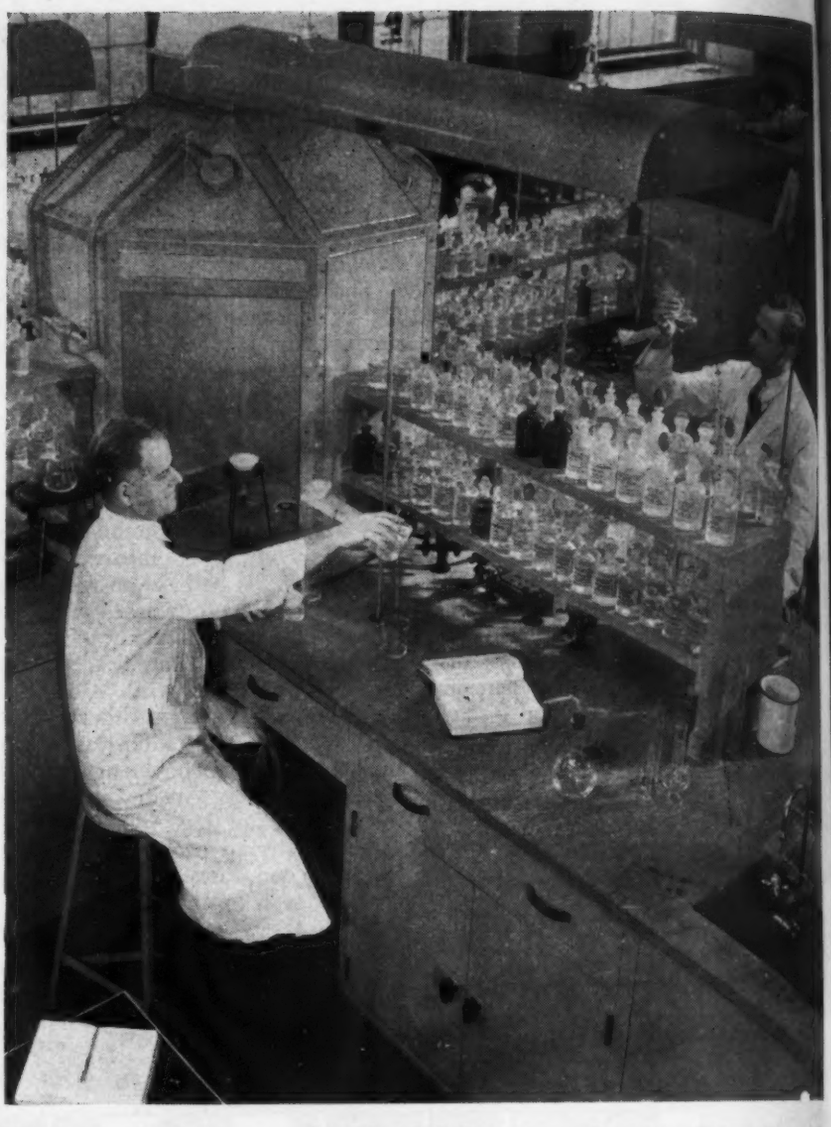
## Work Simplification in the Laboratory—*Merck*

The new analytical laboratory of Merck & Company, Inc., Rahway, N. J., embodies in design and layout many excellent examples of applied work simplification.

The workbench of traditional design has given way to a cross-shaped one. With this arrangement each chemist finds himself with an L-shaped work table, making it possible for him to reach any part of it in a single stride. A desk in the fourth corner completes the rectangular work area. This again is within easy reach of any part of the workbench.

Although the new work space is the same length as the old, the distances traveled from one point to another of the work table and to the desk were considerably greater with the straight bench. In the old method the chemist walked along a straight line; now he uses the hypotenuse of a triangle formed by two parts of that line.

In addition to the saving in steps, the new bench design has also resulted in a consolidation of equipment. The clean glassware cabinet has double access and is used jointly by two chemists. The conventional fume hood has been replaced by a four-place one, located at the intersection of the cross bench. On each of the benches is a double reagent shelf, accessible from both sides. At the ends of two benches are individual sinks with hot and cold water and built-in waste receptacles. On each bench are outlets for gas, water, distilled water, compressed air, vacuum, and alternating current, all with double access.



**Work simplification invades Merck laboratory where traditional workbenches have been replaced by new ones laid out in form of a cross. A chemist can reach any part of his L-shaped table in a single stride**

## Time Study as Aid to Improvements—*Armco*

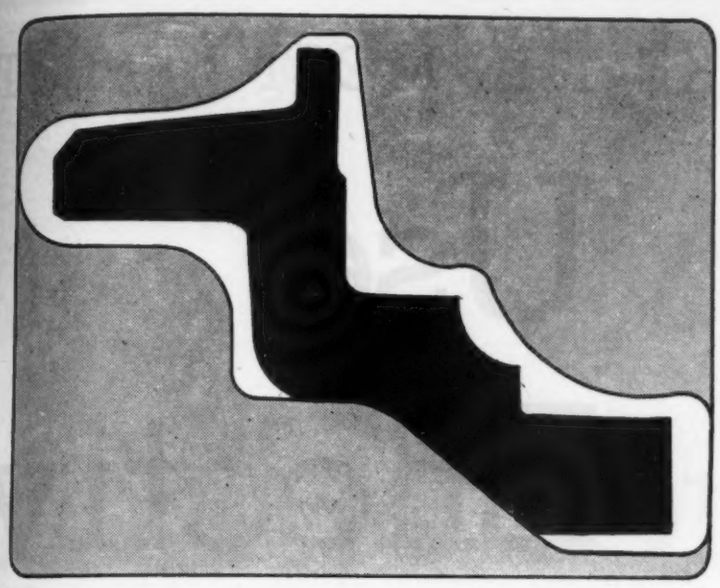
At American Rolling Mill Company, time study is used for:

**1. Cost Analysis.** The engineer assigned to the job makes a minute analysis which enables him to compare, element by element, the high-cost operation with the like product that has a lower cost. Sometimes a process chart is used to advantage in determining where the costs differ. Test questions are applied: (1) Is this step necessary? (2) Can this operation be eliminated? (3) Can it be simplified or improved?

**2. Job Analysis.** To evaluate a job properly, each element must be carefully described and rated. Such major factors as safety, skill, experience, working conditions, mental and physical effort, and responsibility for material and equipment are considered. A detailed time study of the job is required before a proper weighting can be determined.

**3. Methods Improvement.** New operations offer the greatest opportunities for improvement. Ordinarily, the operating supervisor's first concern is getting a quality product. After the desired quality is assured, he concentrates on production, calls in the industrial engineering department, and asks for assistance in working out the most economical methods. Time studies are made to determine ineffective moves and unnecessary steps. Movies of similar jobs in other plants are studied, and shown both to supervision and to operators. The final analysis, with a list of suggested improvements, is reviewed with the foreman and superintendent, who usually agree to try out most of the proposals, and adopt them if practical.

**4. Plant Layout.** Time study is almost a necessity in modern plant layout work. Routing and flow charts are prepared; machine capacities, power limitations, and mix of material are analyzed; future requirements are anticipated as far as possible. During these days of war production, the most important fact to keep in mind is a layout that can be used upon the return to peacetime business.



Original rough forged ring.....2198 pounds
Mill section blank (present)..... 740 "
Material saved.....1458 "
Finished section outline
2000 pieces per month, material saved..... 1458 tons
24,000 pieces per year, material saved.....17,496 tons

**A forging that weighed 2198 pounds was replaced at American Welding by forming a mill section into a ring and welding it. The saving on each piece amounts to 1458 pounds of high-grade steel**

**5. Establishment of Standards.** Armco uses a uniform system for setting standards in all departments. Time study is used to determine a standard time for each operation; the men are paid a premium (in addition to a guaranteed base rate) for all production above standard.

## Redesign of Assembly Equipment—*DeVilbiss*

An example of methods improvement with resultant increased production from the redesign of equipment can be seen in the assembly and testing of the Type MBD spray gun at the DeVilbiss Company, Toledo. This gun involves about 50 separate parts. The assembly procedure, in its original form, was based on the facilities of a horseshoe bench.

This type of bench required considerable area to store and move parts and assemblies. To keep total space to a minimum under such conditions, each operator had to handle many parts. This also reduced the space available for assembly fixtures, since storage of parts for one operator used nearly all the room within that person's working area.

A better method of storage and transporting parts was found to be the circular turntable. It consists of two turntables around which are located six small assembly benches. The circular tables permit handling of individual gun assemblies, whereas the horseshoe bench required handling of racks of guns. This reduces fatigue and puts the job within the handling limits of women.

The old method required 6½ operators for a production of 30 guns per hour; the new requires 5¾ operators for a production of 60 guns.

With the new method several holding and locating devices were added, many of which permit the handling of two units at one time. The parts are distributed to avoid body movements, and located so that the part is not transferred back and forth from one hand to the other.

When the new layout was designed, it was found desirable to reduce the size of the space required for fluid tips and needles. By altering the tray design to pack the pieces more closely, the space was reduced from 1400 to 793 cubic inches per 100 units. The new tray permits better storage and handling, and assures the use of old stock first by being placed on separated shelving instead of being stacked in a pile.

## Replacement of Riveter—*American Central*

A pneumatic squeezer, much more powerful than the riveter it resembles, is being used by American Central Manufacturing Corporation, Connersville, Ind., to flatten port flanges on collector ring sections.

The collector ring on which these ports appear is the device that collects the exhaust gases from a 14-cylinder airplane motor and directs them to the turbo-supercharger, which is driven by exhaust gas pressure.

The ports are stainless steel reinforced by welding to take bolts through flanges at the corners. The pneumatic flattener works ideally in this application to squeeze the surface of the port flange to almost perfect smoothness, thereby eliminating grinding or surfacing.

With 50 pounds of air, the pneumatic port flattener develops a pressure of 16,500 pounds on the collector ring surface around the port opening. Lloyd Davidson, development engineer, estimates that 90 pounds of air would develop a squeeze pressure of more than 30,000 pounds on the same machine, if desired.

## Using Smaller Blank—*American Welding*

By forming a mill section into a ring and welding it, the American Welding & Manufacturing Company, Warren, Ohio, has replaced a 2198-lb. forging, from which a tank turret gear ring was formerly machined, with a closely dimensioned rough blank weighing only 740 pounds. The tank turret gear ring is for the M-4 tank, the General Grant, and is 81¼ inches in diameter.

A saving of 1458 pounds of high-grade steel, amounting to twice the weight of the finished piece, is thus effected, by reducing the excess material formerly cut away in chips. Machine time and skilled labor also are saved on this improved blank.

As shown by the drawing, the forged blank required a cross section of much greater area than the finished piece, to permit machining the complicated profile from a rectangular piece.

The intermediate outline on the drawing shows the new mill section.

HOW TO MAKE THE MOST EFFECTIVE USE

# STEP 3 Use Effective

**Utilization boards (1) give General Electric foremen and supervisors a picture of just how much each machine in each shop is being used, (2) show work ahead of each machine, (3) help management determine whether any department has excess capacity to handle work for another that is overburdened, or whether machines can be shifted from one department to another.** **Case study on page 171**

SE OF EQUIPMENT

# Production Control

IN ITS BROADEST INTERPRETATION, production planning and control includes the control of the manufacturing operations and the corollaries involved in taking raw materials into the plant, transforming them into finished products by means of machines and processes, and shipping those products to their purchasers. Hence a complete treatise on the subject would cover materials control, stores control, salvage control, tool control, quality control, and cost control, as well as scheduling work through process against time, and correcting for deficiencies that may result.

Here, however, because of limited space, the subject is being confined to the control of the flow of work, the principles involved, and the organization necessary. The Gantt chart is selected as a specific control tool to be described, because it is a nonproprietary method, and certainly without any intent to disparage the several thorough and effective proprietary systems of machines and records on the market.

The development of precise planning control is vitally necessary to speed the flow of production and to relieve supervisors from routine operation, so that they can concentrate upon technical problems, training of available personnel, and maintenance of sound labor relations.

Planning requires the correct balance of centralized control—to govern the over-all operation of a plant—with decentralized operation that permits supervisory personnel to secure rapid flow of work in their departments. Treated here are the principles involved in obtaining this condition and the methods to be used in obtaining forecasts of future difficulties and in preventing their occurrence. Serious losses in war production have come about because supervisors and others have not planned work far enough ahead to take the action that is sometimes necessary to prevent avoidable idleness of equipment.

For purposes of illustration, a movement-of-paper chart, Figure 1, is used to represent the manner in which planning and production control may be achieved, particularly for the manufacture of a wide diversity of products, each requiring several operations. In continuous-process manufacture, on the other hand, the problems of planning and scheduling are simpler, since control of output depends upon a rate of movement which is mechanically established.

At the top of the chart, under the two divisions, "Central Planning" and "Shop Planning," are listed the members of an organization who are largely concerned with planning. Arrows represent flow of information, and circled figures refer to work done in connection with this information. A description of the work follows:

## 1. Initiating a Plan

Upon the receipt of a manufacturing order from the sales department, an order writer in a central planning department prepares a shop order—for each part as a component of a complete order—which outlines the technical information necessary for planning and scheduling the order correctly. This information includes total quantity of the part required, material to be used, approved sequence of operations, tools and machines that are to be used, points of inspection, and normal times required for the operations. These times include the

operating times plus times spent in preparing the job—setting-up, change-over, and so on. Furthermore, alternative facilities that may be used are indicated.

By the development of technical information of this character and in this form, routine planning later can be undertaken by employees who are technically less skilled than the personnel that initially set up or originated this information. The assembly of these data, usually in the form of master route cards or operation sheets, is sometimes a slow and difficult job at first. But future repetitive production of parts along standard lines is assured by placing the technical information on paper rather than by having it remain in the heads of operating personnel.

At times there are conditions where new products come along, or major changes and modifications are involved. In these cases, not only must technical data be originated, but consideration must also be paid to the various steps necessary in securing production—for example, procurement of tools and gages, conversion of equipment, preparation of prints and specifications, and transfer and training of labor. Planned times are established for accomplishment, and progress is noted as work proceeds. In other words, it is necessary for a central planning group to assure that the shops will obtain all the facilities that will be necessary for production.

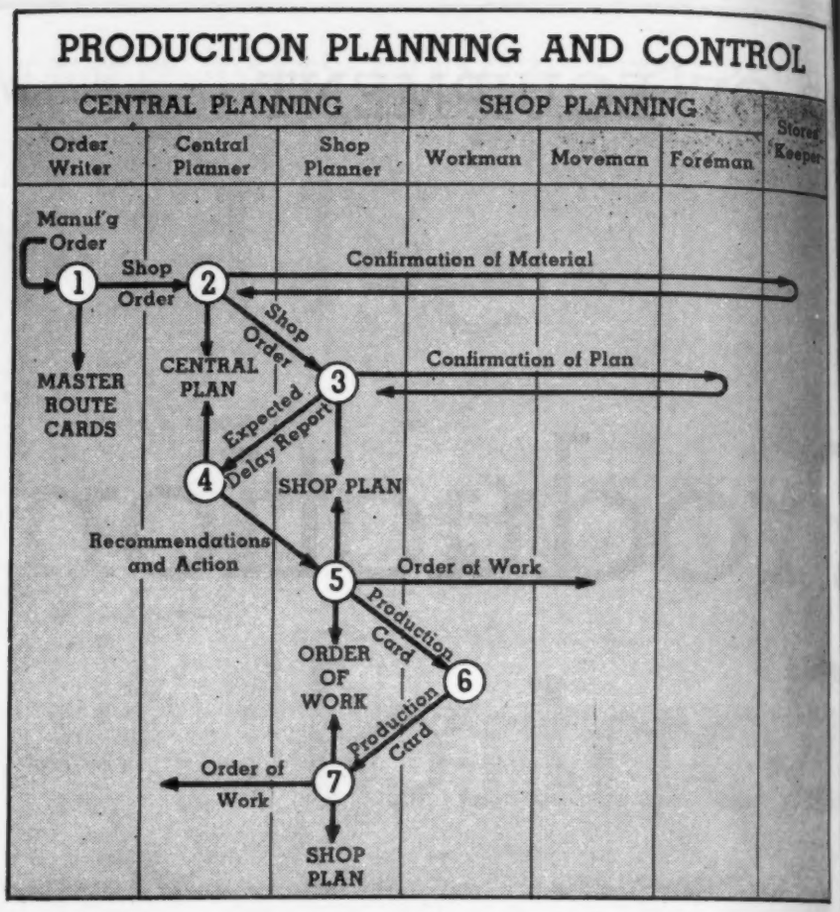



**Figure 1. Arrows on movement-of-paper chart indicate flow of production control information; circled figures refer to work done**

## 2. Reserving Time for Orders

A central planner then receives the shop order, notes the operations required and the machines to be utilized, and checks with the storekeeper to see if raw material is available. If stock is not on hand, he obtains as good a promise date for the delivery of material as possible. The next step is to schedule each operation and to reserve machine times in the future for the work to be done.

In planning for the series of operations necessary for the accomplishment of an order, the central planner aims to keep a swift flow of work and not to put into the shop any orders that may be stopped en route. In this way he holds down inventory-in-process. He does not plan the individual orders at a slow, stretched-out pace, but rather as close together as possible. Of course he allows some margin of safety, dictated by previous operating experience.

There is an advantage in having on hand a summarized picture of the over-all load of a plant through the use of load charts or records that show for each class of machine the hours of work that have been assigned to them by weeks or months, and the remaining capacity that is available. With records of this type, a central planner can better visualize where and when the sequence of operations can take place. This is especially important in plants where a final assembly operation is involved; for the time relationships for production of parts in the shops must be totally coordinated by central planning to a base requirement—namely, rate of assembly of complete units.

Next, each operation is specifically scheduled and time is reserved. One of the outstanding and simplest devices is the Gantt chart,[1] Figure 2. This planning chart is ruled to represent the working hours of a plant, the ruling depending upon the average length of the jobs. In this example, each wide column represents an 8-hour day. To the left of the chart are indicated the machines to which the work is assigned.

An angle opening to the right (⌐) indicates when a job is to be started. An angle opening to the left (¬) indicates when a job is scheduled to be completed. A light line connecting the angles indicates the total time scheduled. Above the light line are written whatever numbers and quantities are needed to identify the job.

In scheduling further work to machines, it is necessary to know the progress made on work already assigned. Thus, as progress reports are received, a heavy line is drawn under the light line in proportion to the amount of work completed. If work is exactly on schedule, the end of the heavy line will be under the proper date and hour. If the work is behind or ahead of schedule, the end of the heavy line will be behind or ahead of the date.

In scheduling work into the future, a certain amount of unplanned time is reserved each week to accommodate delays in the execution of orders caused by lack of help, insertion of rush orders, and so on. By so doing, the necessity for frequently changing

[1]For a full description of the preparation and use of Gantt charts, see "Handbook of War Production," E. A. Boyan, McGraw-Hill Book Co., New York, 1942.

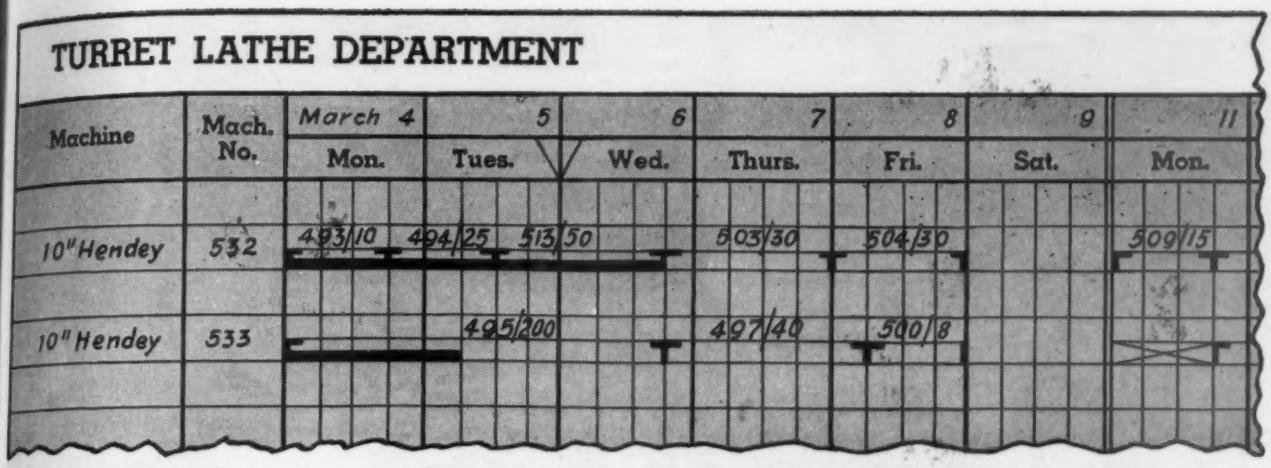



**Figure 2. A Gantt chart provides a simple and effective technique for scheduling operations**

and revising plans is reduced. Furthermore, if the margin of safety is exceeded because of greater delays in the plan than were normally expected, sufficient time must be reserved—through the representation of crossed lines—to make up for the excess delays before any new orders are scheduled.

When the starting dates of each operation are decided upon, the central planner notes this information upon the shop order. These orders are maintained on file until about a week before the beginning date for each operation. Upon confirmation of material availability, they are sent down to the shops concerned. Through the withholding of orders to a time immediately preceding their manufacture, any subsequent change in the initial planning dates may be readily undertaken.

The important objective is to relieve the manufacturing departments of the necessity of making constant revisions. Central planning should perform the function of assuring that, once orders are issued, few if any changes in plans of the departments will be required. This may well justify a certain proportion of routine follow-up activity (expediters and chasers), particularly where the necessary flow of work depends upon the receipt of supplies or manufactured parts produced in other plants.

## 3. Scheduling Work in the Shop

Upon the receipt of shop orders, a shop planner, acting as an assistant to the foreman, schedules the work in the department in accordance with the tentative starting dates and instructions issued to it by the central planner. His job is more definitely to schedule the starting times of each operation, recognizing the situation current in the department. Central planning can only establish tentative dates to govern flow of material between departments; shop planning must establish definite dates for flow within the department, or advance the reasons why accomplishment cannot take place. And when shop planning transmits to central planning information on what it can or cannot do, the latter may take steps to provide adjustments or develop executive action to eliminate the potential delays, depending upon the seriousness of the condition.

A shop planner thus lays out the work for the department in a manner similar to the central planner, with the exception that he can better visualize the current conditions in the shop and fix more closely the starting dates of the operation. He then secures the recommendations and adjustments of the foreman with respect to the plan.

Two major devices, in general, demand the attention of plant management in the planning of shop work—namely, Gantt charts and schedule boards. Both seek to show the scheduling of operations in proper sequence. Gantt charts show the time relationships among scheduled operations on various equipments. Schedule boards, depending upon their character, may or may not.

The simplest type of schedule board calls for three sets of hooks for each machine or workplace. The top hook holds a work ticket representing the job currently on the machine. The middle hook holds the ticket for the next job to be done, and the bottom hook holds tickets for all future jobs arranged in proper sequence. There are schedule boards on the market suitable for a wide range of products.

## 4. Anticipating Delays

Where the instructions on starting dates issued by central planning cannot be followed, the shop planner prepares and forwards to central planning an expected-delay report, listing orders that cannot be started, with reasons why. The superintendent and central planning pay particular attention to these delays; although they are beyond the scope of the foreman, they can be eliminated by higher authority.

For example, central planning can refer to its charts and determine the effect that the anticipated delay in starting a job in one department will have on the succeeding departments or on the final delivery date. It is able to decide immediately whether it will be practicable, and in the interests of the company, to prevent this delay—by authorizing overtime, for instance, or by performance of the order in a less economical way than ordinarily followed. Sometimes less urgent orders may be halted in production to give priority to a delayed item.

Central planning then returns to the shop planner the expected-delay report, stating the action that has been taken or the decision made. The shop planner adjusts his plans according to this information.

Through the above technique the majority of delays are foreseen and brought to the attention of management before rather than after they have occurred.

## 5. Specifying the Order of Work

Then an order-of-work sheet is developed, several copies being made. This is the basic operating document

**Tool system at Federal Manufacturing & Engineering Corporation, Brooklyn, controls the drawing and the return of all tools and machine attachments, stops loss of tools and excessive breakage, prevents the issuing of wrong tools on a job, provides a perpetual inventory and a record of tool activity**

used by the foreman in running the department and serves:

1. To advise the workman in charge of departmental transportation as to the materials and tools that will have to be placed at each of the machines he customarily services.

2. To make a final check of the availability of tools and supplies and raw or in-process material.

3. To control the distribution of orders to workmen and to constitute a cumulative record of actual department performance to the plan.

4. To advise the superintendent or works manager respecting department plans for future operation.

Production cards are prepared from the order-of-work sheet to serve as job notifications for workmen and eventually as job records of production. When a workman reports for assignment of work, he is given a production card, and the time of starting is recorded on it. The start of the job is also registered on the order-of-work sheet. Where single operations extend over several days, time cards may be issued to serve as interim records of production.

Where a schedule board is used, and depending upon shop operating conditions, an order-of-work sheet may not be necessary for dispatching purposes. However, it does have a distinct advantage in that several copies may be made and distributed to proper personnel for accomplishing the task of arranging for proper facilities. In addition, the recording of delays may readily take place.

## 6 & 7. Comparing Progress With Plans

When the job is completed, the workman returns the production card; the finishing time is recorded; and the completion of the job is registered on the order-of-work sheet. If, for any reason, a job is not started or completed as planned, the reason for the delay is stated on the order-of-work sheet. Thus, at the end of a working period, the shop planner has:

1. A complete record of progress, so that he can transfer information to his records and plan future work on the basis of past accomplishment.

2. Statistical information of performance against the plan—e.g., planned times versus actual times to measure efficiency of department.

3. Information for transmittal to central planning, which, in turn, can keep its records in accordance with actual conditions in the shop so that new orders can be accurately planned.

The planning personnel must recognize that their task is not to limit or confine the activities of operating personnel but rather to serve them and to make their work easier. The popularity of any production control system rests upon obedience to the dictum of the American workman "who wants what he wants when he wants it," and who is irritated when he doesn't get it.

Furthermore, no planning method can exist unless the right men are chosen to operate it. Shop planners, for example, must have the confidence of the men with respect to technical experience. It is better to use men who have had technical

experience in the shops for which they will plan work and to train them in planning methods, than to utilize an "outsider" in whom the workmen repose no trust and who will require shop training.

* * *

As can be seen, planning involves not only the setting of plans, but their follow-up, progress in turn governing the development of future plans. Certain general rules of action govern the development of precise planning techniques:

1. Establish a definite planning procedure, yet make certain that the natural abilities of the men concerned with shop operation are not hampered by red tape.

2. Decentralize planning sufficiently so that operating departments have a voice in arranging jobs for most efficient operation.

3. Relieve supervisors of the details of planning production so as to permit them to undertake true "supervisory" work.

4. Prevent delays, rather than make up for them.

5. Continuously measure performance against plan.

6. Choose the right planning personnel and see to it that they provide the proper service.

Planning and the men concerned with it are the nerve center of the plant. Organize it well, and smooth operation will be fostered. Only through careful planning and control has industry been able to meet its obligations under the difficult conditions that obtain today. Only through equally careful planning will industry be able to steer a straight course through the uncharted seas of the post-war world. For those men in plant operation, therefore, who are already looking ahead to post-war conditions, study of the case examples that follow is recommended. In those examples they will find techniques that are working successfully today under wartime conditions—techniques that will work equally well in some other plant tomorrow, in time of peace as well as in time of war.

## Flow Charts and Load Boards—*Allis-Chalmers*

Production flow charts and product load boards have enabled the West Allis Works of Allis-Chalmers Manufacturing Company to establish schedules based upon capacity to produce, and to predict shipping dates accurately on all new orders.

The first step in this process, reports J. F. Costigan, superintendent of production control, was to establish detailed manufacturing cycles for all products. It was found that, despite variations in design of custom-built equipment, the over-all manufacturing time for a particular size and type of product could be fairly well standardized. This information was worked up in the form of a production flow chart (a variation of the Gantt chart) which lists all the parts of a given piece of equipment, the operations to be performed on these parts, and the normal length of time required for the various operations. The chart also indicates how the parts must come together in subassemblies and final assembly.

From this chart the production control department can determine, in addition to the over-all manufacturing time required, the number of days ahead of the shipping date that any operation must start and finish.

Next came the determination of shop capacity for various products and the current backlog of orders for each of these products. Shop capacity was determined from an examination of past performance and preliminary machine tool load checks for the limiting operations involved. This information is combined with the current backlog of orders on a product load board. A board is made up for each product; there are twelve boards for the products made at the West Allis Works.

The product load board consists merely of horizontal strips stapled to a piece of plywood 17x22 inches. It is painted black and ruled vertically, each space representing a month. A card is made out for each unit on all contracts, showing contract name, size of unit, unit number, and priority. These cards are then inserted under the month in which the unit is scheduled to ship.

With all contracts on a particular product posted to the board, the following information for that product is available at a glance:

1. Shipping schedule for all contracts undertaken

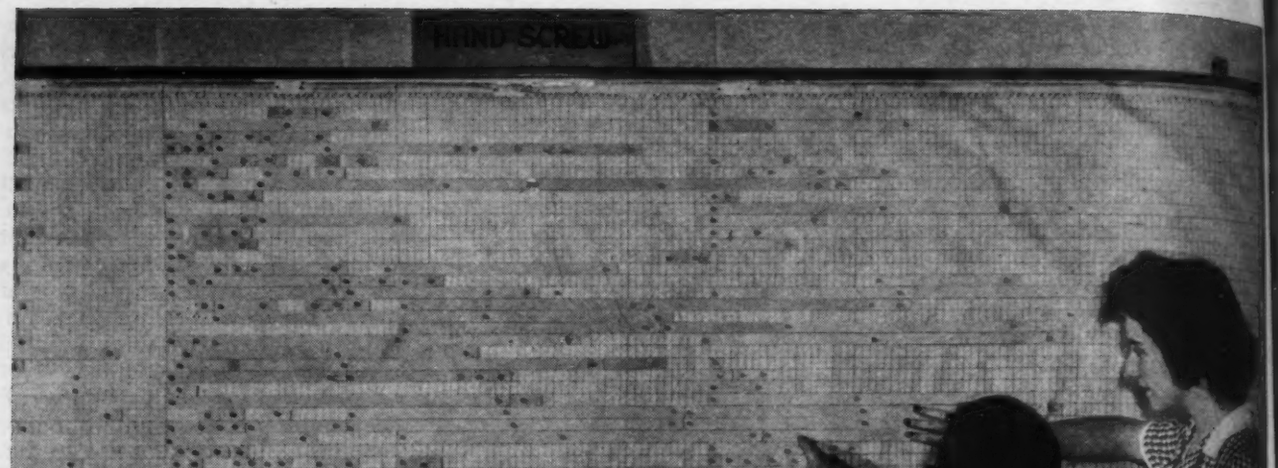
2. Approximate capacity for each size and type of that product

3. Current backlog of orders

4. Dates when plant has capacity to start shipping new orders

The board is kept up to date by posting new orders as received, and by removing cards as orders are shipped. Once a month the board is

**Product load boards, used in conjunction with production flow charts, enable Allis-Chalmers planners to set up schedules based on capacity to produce, and to predict shipping dates with unerring accuracy**




**Load charts at Walter Kidde & Company are used to show the work ahead of each machine. Orange strips of paper show raw materials on hand; blue strips indicate raw materials still to be obtained**

photostated, and prints are distributed to sales and manufacturing executives.

In estimating shipping dates on new contracts, the following factors are taken into consideration:

**1. Engineering Time.** On all requests for delivery estimates from the sales departments, the various critical components of the order are listed. For each of these parts, the dates are given on which bills of materials will be sent to the production department.

**2. Material Procurement Time.** For controlled materials, Schedule III of CMP Regulation No. 1 time is allowed. For other parts, the purchasing department furnishes production control with an up-to-date list of procurement time.

**3. Methods Planning Time.** Time must be allowed for establishing a plan and schedule for doing the work, including the time necessary for the design and manufacture of tools, jigs, and fixtures. In the manufacture of custom-built machinery this is an important factor, because practically all orders involve new design and methods. In general this work can take place in the time required to obtain materials.

**4. Manufacturing Time.** This time is taken directly from the production flow chart for the size and type of product involved.

The date upon which the company can ship the new order is then determined from the total of items 1, 2, and 4, or of 1, 3, and 4, whichever is the longer. The dates determined from this procedure must, however, be referred to the product load board. If there is no space available at this date, if the present backlog of orders extends beyond this time, the new order must be scheduled for the first open space.

The production schedule for the new order is then worked out from the production flow chart. Working backward from the scheduled shipping date, the dates are established on which each operation should start and finish. In this manner, schedules for new orders are truly based upon known ability to produce.

## A 90-Day Parts Schedule—*Walter Kidde*

To determine what parts and how many must be produced in a given month, Walter Kidde & Company takes into account all contracts and orders that call for delivery prior to the end of the month in question, including orders due that month and unshipped prior orders.

For each part and subassembly called for on a given assembly, a master card has been punched, giving description, part number, number of pieces per assembly, and class of inventory—that is, whether a part or a subassembly. For each customer's order, a shipping order is prepared by the engineering department, which breaks down the customer's order into final assembly numbers.

In the middle of the month a list is made by assembly numbers of the total quantity of each type of assembly required to meet all contractual needs calling for delivery prior to the end of the month, as well as the quantities required in the two months

following. The master cards for each of the assemblies are then pulled, the cards are reproduced, and the quantities extended automatically.

From the cards produced in the first breakdown, those representing the subassemblies are separated from the parts cards by a sorting machine. The master cards are then pulled for each of the subassembly numbers, and these in turn are reproduced and extended. Out of this second group, cards representing all subassemblies are again sorted and the master cards pulled for these sub-subassemblies. This procedure is repeated until all subassemblies have been completely broken down.

All the cards thus produced are then sorted by part number, and in this manner all like part numbers are grouped together and the cards reproduced on a tape, totals being shown for each part number. Thus, even though the same part is used in many different assemblies which have no direct relationship to one another, it is possible to gather into one spot the total requirements for each part for the coming three months.

Against this total parts requirement, the stock count is compared. The difference between the total quantity required and the quantity in stock represents the shortage of parts. This shortage list is then checked against the stock of subassemblies and final assemblies, as well as against the subassemblies and final assemblies in process, to reduce the number of items still further. The net results are typed on lists which show part number, description, and quantity short.

One list is made for the shop for the parts produced by the company. Another list is prepared of all parts purchased from vendors, and is then turned over to the assembly plant for its guidance in scheduling.

It should be pointed out that this method is not used for ordering materials, but only for the expediting of materials already on order, and for the directing of the activities of the shop in producing the parts most urgently required. The system also serves as a double check on materials previously ordered, and in this way shortages caused by spoilages, losses, or spare part orders not previously planned can be picked up and the materials ordered at least three months in advance of the time in which the shortages will occur.

This method of operation also provides an excellent tie-in with the Controlled Materials Plan, which forbids the receipt of materials that will not be consumed within the next 60 days. The purchasing department calls for delivery of only those items that are listed on the schedule for the coming two months; the shop produces only the materials called for on the schedule for the coming two months; and the purchasing department is pressed only for the delivery of raw materials for those items that are to be produced in the coming two months.

Not only has the plan greatly improved deliveries; equally important, it has reduced inventories.

## Daily Check on Parts Production—*Ford*

A system of production control which was initiated in the Lincoln plant about 15 years ago will probably be in operation soon in all Ford Motor Company plants. Although primarily suitable to small daily production, it has been adopted by the Highland Park plant, which is working on a precision instrument contract, and has been found so efficient that an outline of the system is being prepared for possible adoption at the Rouge plant.

This system consists of charts, 14x18 inches, with 50 lines. One part number is written on each line. A daily schedule is set up to show what the daily production of each part should be, and a line is extended on the basis of what is actually produced. In this way it is possible to keep an accurate check on the production of each part each day, and to see by the length of the lines which departments are producing beyond the schedule set, and which are below it.

## Utilization Boards—*General Electric*

Utilization boards are used at General Electric Company to give foremen and supervisors an accurate picture of just how much each machine in each shop is being used, together with an indication of the work ahead of each machine. The hand-in-hand problems of material and employee availability are the two factors that complete the picture.

A graphic means of portraying this picture to management and supervisors serves two purposes:

1. It enables management to determine whether any department has sufficient excess machine capacity to handle work for another department that is overburdened, or whether a machine or group of machines can be shifted from one shop to another.

2. It precludes the possibility of misunderstanding among superintendents as to the actual need for taking a machine from one shop and giving it to another.

As reported by H. M. Atwood of the planning and wage rate department at the Schenectady Works, an indexing system has been developed which involves the use of a metal board, hinged to fold in three parts, with each section slotted vertically to accommodate four 2-in.-wide columns of cardboard inserts. Each section is 9x18 inches.

The first column at the left side of each of the three sections contains name, size, and number of each machine tool. The second, third, and fourth columns show the names of the workers on the three shifts. This information is typewritten on cardboard stock, perforated to provide the inserts. Colors give other pertinent information. White denotes a standard machine in good condition and required for regular production. A machine listed on a yellow insert is available for transfer or sale. A pink insert means that the machine is restricted because of a special set-up or poor condition.

In the personnel columns, the regular operator's name is typed on a white insert and placed opposite the machine according to shift. A white insert with diagonal lines indicates intermittent operation of the machine it covers. A brown insert indicates no operator and no work for a machine during the shift under which it is carried. A salmon-colored insert with an asterisk indicates an open shift with an operator needed but not available. A blue insert with the operator's name typed on it shows that he is a learner. A red metal indicator superimposed on the right side of a personnel insert shows that an operator is working a long shift. A machine under repair or being moved has black inserts opposite it in all three shift columns.

Building number, department name, work center, and date are shown on inserts at the top of each board. Machines are grouped by GE code number, which is indicated on a white insert in the first column. A green insert under each code number carries the name of the work center.

What really makes the system pay off is using it to provide a picture in the actual sense of the word. Once a month, each section of the board is photographed. Then 8x10 prints are distributed to superintendents, assistant superintendents, foremen, and planners in each shop. Thus each

man has a quick-reference utilization chart on every man and machine under his jurisdiction. This expedient not only saves time that would be required to make up and maintain a large number of boards; it also provides an easily kept permanent record of machine tool utilization in any of the shops at any period. Copies of photographs are kept on file in the works manager's office.

The utilization boards have more than paid their way. Soon after the system was initiated, an order for a large quantity of apparatus required additional lathe capacity in the shop ordinarily handling that type of work. The photographs showed that another shop had adequate third-shift lathe capacity to handle the job; the order was filled on schedule by doing the lathe work on those machines, and an 18 percent improvement in machine tool utilization was made.

## "First Piece + Patrol + Last Piece" Inspection Plan for Control of Defective Parts—*Westinghouse*

An increase in production of as much as 30 percent, and a corresponding decrease in unit cost, have resulted from the application of quality control at Westinghouse Electric & Manufacturing Company.

Quality control is the name applied to a technique which complements the usual inspection procedure and focuses a spotlight on the existence of unfavorable conditions before evidence that difficulties are developing would otherwise become available. It puts inspection closer to the beginning of the manufacturing cycle, and answers two questions:

1. Will defective parts be produced by this set-up and tooling?

2. What is the cause for production of these defective parts?

One of the most commonly used methods of quality control at Westinghouse is "first piece + patrol + last piece" inspection, which can practically eliminate production of defective parts.

When a set-up has been properly adjusted, the machine is permitted to run 15 or 20 minutes. After this initial seasoning period, two or three pieces are taken to the first-piece inspection station. Here all dimensions are carefully checked; height of burrs, if any, is observed; material hardness is measured; and shape of threads is examined. The station is equipped to perform any inspection required on parts handled.

If the parts pass this initial inspection, the inspector fills out an "operation inspection tag," giving complete identification of the part by number, shop order, and description of the operation or operations. Date and time of day when the part is approved are shown, as is the inspector's signature. The tag and part are returned to the machine operator as his authority to proceed with the job. The inspection tag and approved first piece are displayed at the work station while the operation is in work. The inspector has authority to shut down any operation on which the inspection tag is not shown.

First-piece inspection is followed by patrol inspection. It may be made every hour on automatic screw machines; every two hours on welding and brazing machines; every three or four hours on punch press or molding operations. Frequency of inspection is determined largely by rapidity of tool wear, closeness of tolerances, and degree to which the operator has become quality conscious.

On the patrol inspection, general conditions—such as lubrication, material feed, cleanliness, and safety—are observed. The inspector then compares a part with the first piece inspected and passed. The parts should be identical; any difference between them must be accounted for.

If the part is satisfactory, the inspector enters time of inspection on the tag and notes number of pieces completed. If the part is not satisfactory, he removes the operation tag from the machine, and this automatically shuts down the operation. The operator then proceeds to correct his tools and set-up until everything is satisfactory again.

At the end of the run, the last piece or two are inspected to see if there are any changes in dimensions or quality between them and the first part. If tools need re-dressing, the inspector notes the fact on his inspection tag. This serves to warn the foreman that the tool must be refinished before another run is started.

All completed inspection tags are filed by part number. From them it can be determined whether or not a part is difficult to make to standards, in which case a change in design, tooling, or method may be advisable. If this review reveals that set-ups once made continue to the end of the run without producing defective parts, then it may be assumed that the method of manufacture is satisfactory from the quality angle.

## "Line Float" Check Plan—*Ohio Crankshaft*

Production control in the automotive division of The Ohio Crankshaft Company, Cleveland, involves the use of a scheduling sheet and a visible card index file. On the sheet are charted the time when a shaft goes into the line and the time when it should leave. Standard hours for the job, together with the actual working hours, are recorded.

This is done in the planning and scheduling department by a scheduler who is advised of line progress by a dispatcher charged with the responsibility of maintaining a constant check on the various crankshafts or job lots. By means of the card file, the actual work on the shaft is recorded so that an immediate check is possible. Information for the file is derived from dispatchers' reports and from operators' time cards which reveal how much work has been done on a given shaft in a given day.

A different control system is in effect in the aviation division. Here an inventory or "line float" system shows how many pieces there are at each operation. This check is made every morning at 4 o'clock by a third-shift expediter. It enables supervision quickly to note any production delays and to take steps to correct the trouble.

Rough forgings go into the line as fast as they can be absorbed. A record is kept of this number, also of pieces going to salvage or consigned to scrap. Thus the line is always full. In fact, the line is slightly "overfed" in order to provide ample work for all.

## Authority for Shipping—*American Type Founders*

It seems as though industry has always been handicapped by paperwork systems. Either a given system had shortcomings in the number of people it reached or the lack of information it conveyed, or it would be just the opposite and be so voluminous as to swamp the various persons and departments with records.

As a case in point, G. S. McKee, works manager, American Type Founders, Inc., Elizabeth, N. J., reports that his company had what were called AVO (avoid verbal orders) and RMA (returned merchandise advice) forms, which were used whenever any articles other than finished products were shipped from the plant. There always seemed to be some doubt as to which form to use, and it reached a point where the different depart-

**A daily check at four in the morning by a third-shift expediter shows up production delays in the aviation division of The Ohio Crankshaft Company, enables supervision to take corrective steps**

ments and divisions used either one—and sometimes a plain memorandum. This resulted in much confusion because the person originating the form would often neglect to notify all the persons involved.

For instance, if a rejected item was being shipped back to a vendor, often the accounting department would not be notified, and so the credit for the article would not be followed up. At other times, when an article was shipped from the main plant to one of the branches, the branch was not credited or charged, as the case may have been.

In order to eliminate this slipshod method, the company devised a form known as a "shipping authority." This is made in seven copies: (1) Authorization to shipping department; (2) packing slip which moves with material to consignee; (3) notice to purchasing department to take action, if the account relates to a purchase order; (4) copy for the accounting department which will make the necessary bookkeeping transfers; (5) file copy for the originator of the shipping authority; (6) copy for the expediting department which follows through and sees that the material has reached its destination; (7) copy mailed to consignee who signs and returns it to the originator of the authority, giving conclusive proof that the material has been delivered.

This may seem like considerable paperwork, but after giving it a fair trial the benefits from this shipping authority have more than offset the extra clerical work. Now every person or department involved is notified automatically, and no one can plead innocence because someone neglected to advise him.

## Control of Quality—*Ryan Aeronautical Company*

Factory errors, once spotted by inspectors, are prevented from being repeated at Ryan Aeronautical Company through the functioning of an effective quality control system.

In most factory organizations, the inspection department must track down the cause of each error, decide how the cause can be eliminated, make recommendations for correction, and check to see that the recommendations are followed. At Ryan, on the other hand, the inspection department's responsibility ends when it finds an error. The quality control department takes over at that point.

Faulty parts, poor materials, or other deviations from specifications are promptly reported by inspectors on an "inspection discrepancy" report, which is rushed to the quality control manager within 30 minutes after the inspector spots an error. The quality manager passes the form along to one of his liaison men, who immediately tracks down the cause of the error and reports back. Within a couple of hours, and in critical cases within a few minutes, the quality manager takes action on the condition reported, and makes his recommendations for correction. Within 24 hours he gets a reply from the department head involved, indicating what action has been taken. The action reported taken is confirmed by one of the quality control liaison men, and the mistake becomes a closed chapter.

Another reason why quality control has lowered scrap losses, and in many cases actually speeded production, is that it brings engineers and production men into closer teamwork. In every plane factory there is endless discussion because engineers draw blueprints specifying tolerances much closer than production men think necessary. The Ryan quality manager believes production men should have the chance to question tolerances they think unreasonable, and so he developed what is known as an "unsatisfactory tolerance" report. This form may be filled out by anyone in the factory from leadman up. It shows what the questionable tolerance is on the drawing, and what the man in the shop thinks it could be. The quality manager studies the blueprint involved; if he agrees that the report is reasonable, he writes an "engineering change request" and takes up the case personally with the proper authorities in engineering.

# HOW TO MAKE THE MOST EFFECTIV USE

# STEP 4 Maintain Services

Color-spot system at Ohio Crankshaft prevents the oiling crew from making mistakes. Hand truck carries needed lubricants and tools

INSPECT FREQUENTLY, repair promptly, lubricate properly—in these words lies the formula for keeping plant machines and services operating round the clock. Disregard any one of these elements, and trouble will be just around the corner and coming up fast. It would be fine if motors, machines, lighting systems, and all the other equipment in industrial plants could get along without any attention after they have been installed and put in operation. Designers are doing their best to bring that condition about, but it is not yet here. Until it does come, operating executives must recognize that all equipment needs a certain amount of skilled attention. And they must see that it gets this attention or else be prepared to pay the much higher price exacted by neglect.

Inspections can be costly, inefficient, and of indifferent value, or they can be highly effective in helping to keep equipment in tip-top shape for wartime demands.

To be of maximum effectiveness:

**1. Inspections must be made on a regular schedule.** Anything that is done on a hit-or-miss basis, or whenever

USE OF EQUIPMENT

# Machines and for Continuous Operation

there is nothing else to do, is likely to be of doubtful value.

Regular inspection does not necessarily imply daily or even weekly examination. It does mean consistent inspection at intervals whose frequency is governed by such factors as the kind and age of the equipment, its importance, and the severity of the conditions under which it is operated. It may be advisable, for example, to check an important motor or machine, say, once a day, whereas transformers may get along with an examination every three months.

Records showing the results of inspections, troubles encountered, and the kind and frequency of repairs needed by equipment are highly valuable aids in setting up inspection schedules. When such records are used with a plentiful seasoning of practical experience and common sense, it is not difficult to work out a schedule that conserves manpower by avoiding unnecessarily frequent inspections, yet makes certain that equipment is examined often enough to insure prompt detection of any abnormal conditions.

When a definite inspection schedule is set up, some means must be worked out to insure that the routine is rigidly and consistently followed. A schedule is worth little more than the paper and ink required to record it, if it is not carried out. At the same time the system must not be so rigid that necessary or desirable changes cannot be made promptly. It often happens that when a troublesome piece of equipment requiring frequent inspection has been put in first-class shape, or operating conditions have changed, the period between inspections may be changed from daily to weekly or from weekly to monthly. On the other hand, changed conditions may make weekly or even daily inspections necessary on equipment that has previously got along very well with a monthly check.

**2. Inspectors must know what to look for.** This requirement means that an inspector must be something of an expert on, or at least be thoroughly familiar with, the equipment under his care. More specifically, since the purpose of inspection is to detect abnormal conditions and defects before they become serious enough to threaten continuity of operations, an inspector must know where the weak spots are, also the indications of wear or deterioration.

Such knowledge is particularly important for electrical equipment inspectors. Mechanical equipment often gives warning of deterioration by such easily recognized indications as noise, unusual appearance, or substandard output. Nevertheless, barring a complete breakdown of some important part, the equipment may be capable of being operated for a long time. Electrical equipment, on the other hand, usually gives few obvious indications of impending trouble, and is more likely to stop altogether with little advance warning. In other words, it either does or does not work. Therefore, an inspector must know where to look for, and be capable of recognizing, conditions that need immediate correction.

**3. Inspectors must be equipped with suitable tools.** Some defective conditions in both electrical and mechanical equipment can be picked up by eye or ear. For example, there is no difficulty in recognizing burned con-

tacts in a starter or circuit breaker by eye, or detecting a pounding bearing or worn gear by ear. When it is desired, however, to check the insulation resistance of a motor, or measure the wear on a shaft, or determine the drop in output of a lighting system, meters and micrometers and other specialized tools are required.

An experienced inspector may be able to do a fair job with eyes and ears and fingers, but he will be much more efficient and be able to gather important facts which he could not possibly find with his senses alone, if he is provided with whatever tools he needs, in order to do the kind of job that prevents little troubles from growing into big ones.

Mere detection of defects in equipment does not mean much, of course, unless they can be corrected before real trouble starts. Hence the importance of providing adequate repair facilities. There are two angles to this requirement. One is the ability to restore defective equipment or parts to good condition promptly and efficiently. That requires workmen who are sufficiently skilled to be able to handle any job that is likely to be given to them. The other is a stock of spare units and parts large enough to meet any probable demand.

To make these two facilities of maximum effectiveness, there must be an organization geared up to wartime speed, able to handle emergencies without wasting time or effort.

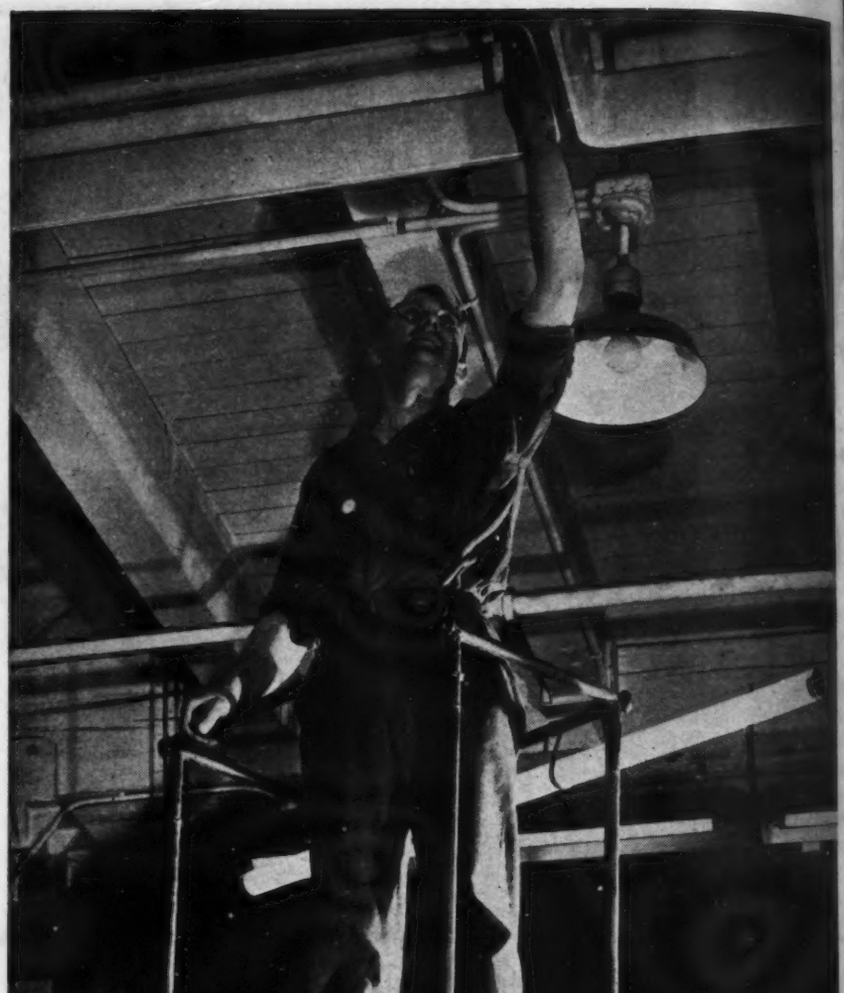
## Scheduled Lubrication

The prime importance of proper lubrication—as a part of the formula for continuous operation—is not always fully recognized. The principle involved—keeping a film of oil or other material between moving surfaces—is simple enough. To accomplish that end, means solving a number of problems. There is, for example, the matter of selecting the correct lubricant. A wide variety of oils and greases is available. Bearing speeds, pressures, and temperatures of industrial equipment range all over the map. An important first step, therefore, is to pick out an oil or grease whose characteristics match the requirements. For this undertaking it is usually advisable to seek expert advice. But it is also desirable to keep the number of oils and greases down to the lowest feasible limit, in order to simplify stockkeeping and minimize the chances of error in application.

Many devices are used for introducing lubricants into bearings. How much trouble there will be in getting this necessary operation performed properly depends on the method used. With automatic systems there is little chance of error or failure. The more the human element enters the picture by way of hand-operated devices, the greater the opportunities for errors, forgetfulness, and plain carelessness. Hence, selection and training of oilers is a problem that must not be regarded too lightly.

Lubrication of production machinery is often left to the operator. With skilled machinists, or when the operators have been on the job long enough to become thoroughly familiar with their equipment and take pride in it, this arrangement usually works out well. However, the introduction of specialized, high-precision machines manned by operators who have come from all manner of callings, and therefore have had no shop experience, has brought up in many plants a problem that cannot be laughed off. Many plants have found it advisable at least to have the lubrication of all complicated production machines, as well as of all service equipment, handled solely by trained oilers.

A good oiler is not made by giving just anybody an oil can or grease gun and telling him to go to it. Lubrication is too important a matter to be entrusted to anyone who is not re-



**Fluorescent lamp maintenance at Allis-Chalmers has been tailored to fit one plant with 3500 lamps, another with 15,000. In the smaller, lamps are replaced as they burn out. In the larger, the job is done systematically, section by section. Case study on page 179**

liable and conscientious and possessed of some acquaintance with machinery. Then he must be told when and how and with what to lubricate the machines in his care. He must be warned, too, that over-lubrication can bring its own troubles; that forcing too much grease into antifriction bearings, for example, can cause heating; also, that over-oiling sleeve bearings is not only wasteful, but also results in getting oils onto things and into places where it may be harmful—into motor windings, for instance.

All who handle lubricants must be thoroughly impressed with the extreme importance of protecting oils and greases from contamination. That means keeping all containers covered, and grease guns and other equipment clean.

Several schemes have been worked out to insure application of the proper lubricant at desired intervals. One method, which is particularly useful with machine tools and other production equipment, provides the oiler with a simple outline diagram of each machine. All parts that require lubrication are plainly marked. A table tells the oiler the kind of lubricant and how often to apply it.

A second scheme that is finding favor uses a color code to indicate lubricants and application periods. That is, each point of application on equipment is distinguished by a suitable color, such as red, green, or yellow. (See the insert in the April, 1943, issue of FACTORY.) If desired, the shape of the painted spot—a square, circle, diamond, or other form—may be standardized to indicate daily, weekly, or monthly application. Or, as is sometimes done, two colors may be used to distinguish application points. One color shows the kind of lubricant; the other indicates the frequency of application. Lubricant containers and application devices are, of course, correspondingly color-coded.

No matter how cleverly devised a system may be, the chances are that the measure of its usefulness will be determined by the caliber of the men who operate it. Both the oiler and his job can be given, to good advantage, more consideration than they sometimes get. As long as the job of oiler is considered merely as a stepping stone to something better, there will be difficulty in getting and holding good oilers. The answer to that one is to make the job of oiler an end in itself, not a stepping stone, with pay commensurate with the importance of the service.

Keeping production equipment lubricated and in good condition is not enough, however, to insure or maintain continuous operation. Raw materials must continuously be delivered in sufficient volume to keep machines busy. Finished or semi-finished products must be moved continuously, both to prevent clogging of temporary storage places and to keep other machines and departments supplied.

Many machines require a continuous supply of water, steam, or air.

Operators must have adequate light. Their workplaces must be comfortably warm in cold weather.

This means that the equipment supplying all the auxiliary electrical and mechanical services required by production must be kept at top efficiency.

* * *

Summing up, in order to keep production and service equipment in condition for continuous operation, it must be inspected often enough and carefully enough to catch defects while they are still minor. Then, defective conditions or needs for adjustment thus disclosed, must be attended to promptly and skillfully. Finally, all moving parts must be prevented from destroying themselves and their supports by keeping them separated by a film of lubricant.

These fundamental requirements are all simple enough in essence, but to meet them properly calls for a force of capable men provided with the necessary tools and facilities. Also, their work must be planned and coordinated. That means proper organization, planning, paperwork, as well as supervision.

How these problems of organizing and conducting the maintenance department have been worked out in selected plants, is told in the series of case examples that follow.

## Preventive Maintenance by Departmental Zones—*American Rolling Mill Company*

Capacity operation largely eliminates open periods during which temporary repairs can be made. With every turn in the week producing to the limit, the American Rolling Mill Company has been forced to find some method that will result in making repairs before a breakdown occurs.

Such a program of preventive maintenance demands an intimate knowledge of the condition of equipment at all times. The element of surprise must be entirely eliminated, and men must be trained to look for trouble before it happens.

For this purpose Armco has divided all major departments into several zones, each small enough to permit a few maintenance men to keep close contact with all equipment in it. Two repairmen and a helper are assigned to each zone, and are responsible for maintaining the equipment in that zone on their turn.

A maintenance inspector checks the physical condition of the equipment in his department each day. This man has had training and experience in both mechanical and electrical work. He makes a written report daily to the departmental maintenance foreman, outlining his observations and suggestions. After a conference with the inspector, the maintenance foreman compiles his repair schedules:

1. Operating repair work schedules, covering work that can be done while the equipment is in operation.

2. Emergency repair schedules covering work that can be done only when the equipment is shut down as a result of some operating delay.

3. Down-turn repair schedules covering work that must be done when the entire department is shut down for eight hours or longer.

The first two schedules are made out daily for each operating maintenance turn and given to the leader for assignment to members of his crew. The third schedule is built up as the week progresses. When the down-turn time comes, a complete repair schedule is released.

Following this inspection system of maintenance, Armco repairs equipment before it reaches the point of breakdown. Maintenance delays during operating periods have decreased, as have emergency demands on maintenance shops and purchasing.

Most important, maintenance foremen are made stronger managers. These men are supplied definite and correct information about the condition of the equipment for which they are responsible, and from this information they can create and direct a constructive maintenance program.

Maintenance crewmen, too, like this system. It relieves them of much of the heavy work necessary when a breakdown occurs. Instead, they do the much more constructive work that follows a closely defined schedule.

Finally, there is a materials adviser for the maintenance department. He has an engineering and metallurgical background, studies material fail-

ures to determine why they occurred, and recommends the replacement of a faulty material with some other that will stand up longer.

## Forms for Close Control—*Walter Kidde*

A lubrication schedule is posted over each machine at Walter Kidde & Company. A card carries the date on which the job should be done and space for the initials of the man who does the work.

Periodic maintenance checks are made on every machine, the time interval being governed by its type. Copies of the forms for each machine are kept in the inspection office, filed under due dates. Every day the forms coming up for that date are removed from the file and sent to the department foremen.

A cleaning schedule, similar to the lubrication schedule, is drawn up for each machine and posted nearby. The cleaning date is entered, and the workman initials it when he has completed the job.

Tests of insulation resistance are made regularly on electrical equipment to prevent breakdown, and a record is kept on special forms.

The bulk of repair work is done during the day shifts, but a skeleton crew is on hand at night. The men keep busy on repair work; if a breakdown occurs, it gets immediate attention.

All maintenance operations are closely supervised, to make sure that a foreman's eagerness to meet production schedules does not lead him to postpone or neglect giving attention to his machines.

B. U. DATE

**INSPECTION RECORD**

Dept. Mach. Description

| MOTOR DATA | TEST MADE | No Load | Load |
|---|---|---|---|
| 1. Mfg. | 1. Terminal Volts | | |
| 2. H. P. | 2. Terminal Amps. | | |
| 3. Volts | 3. Watts | | |
| 4. Amps. | 4. Power Factor | | |
| 5. Phase | 5. Insulation Resis. | | |
| 6. Freq. | | | |
| 7. R. P. M. | CORRECTIVE MEASURES | | |
| 8. Serial No. | M. W. O. | | |
| 9. Type | Date Originated | | |
| 10. Frame | Date Completed | | |
| 11. Fuse Protection | | | |

SWITCH DATA

1. Mfg.
2. Type
3. Rating
4. Thermal Protection

REMARKS:

Inspector .....

B. U. ..... Date .....

**Periodic Maintenance Check**

Machine...Machine No. ...Dept. No. ...Plant No.

- ☐ Wipe and Grease Motor
- ☐ Wipe and Oil Motor
- ☐ Clean Out Safety and Magnetic Switches
- ☐ Use Vacuum Cleaner on Motor
- ☐ Replace Contacts on Magnetic Switch
- ☐ Flush and Change Bearing Oil
- ☐ Clean and Replace Compensator Oil
- ☐ Flush Grease Chamber and Repack
- ☐ Dismantle, Thoroughly Clean Motor, and P Windings
- ☐
- ☐
- ☐

Work Done By .....Total Hours.....Date...

Checked By .....Date .....

**Maintenance forms in use at Walter Kidde & Company have been worked out with care, help make close supervision possible**

## Power Drives—*Manning, Maxwell & Moore*

Three men—a millwright, a belt man, and an oiler—spend their time inspecting, lubricating, and making repairs or adjustments on the mechanical power transmission equipment at the (Bridgeport, Conn.) factory of Manning, Maxwell & Moore, Inc. They are responsible for about 2000 belt drives, including 500 of the V-type, 20,000 lineal feet of flat belt, between 3000 and 4000 feet of line-shafting, and a large number of speed-reducers, together with variable-speed drives, chain drives, clutches, and other auxiliary equipment. About 66 percent of all the machines are group driven.

Since proper selection of equipment has a direct bearing on the amount of maintenance it will require, care is taken to see that all mechanical power transmission equipment put in meets the requirements. Motor loads are accurately measured and checked frequently to make sure that the mechanical elements of all drives—belts, speed reducers—are properly loaded.

Power drives in this plant are preponderantly of modern capacity, ranging from 3 to 5 horsepower. But there are many of them, and they are scattered over an area of more than 300,000 square feet. Production demands make it imperative that there be no delays due to breakdowns.

Every day the millwright and belt man, working as a team, go over the

**Millwright, belt man, and oiler at Manning, Maxwell & Moore inspect, lubricate, and make repairs and adjustments on mechanical power transmission equipment. They service some 2000 belt drives**

entire plant. Every drive is given at least a quick check. It does not take long, for example, to see whether a flat belt is running true, or whether it is wobbling, flapping, or pulling off to one side of the pulleys. These and other evidences of defects call for immediate attention. Belts are also inspected frequently for cleanliness, tension, condition of the joints, and to determine whether there is any separation of the plies.

With V-belts, cleanliness of belts and sheaves, even tension of all strands and fraying of the covering are given particular attention.

Variable-speed drives, speed reducers, and chains are likewise checked to make sure they are in good condition and operating properly.

Clutches on group-driven machines are operated many times a day, hence are subject to severe wear and require a good deal of attention. Consequently, they are inspected daily. As soon as a clutch starts to slip, it is replaced with a spare and sent to the repair shop for relining.

Oil ring bearings are used on all lineshafts, antifriction on other transmission equipment and in motors. The latter help to keep equipment well oiled or greased, because the bearings require lubrication only two to four times a year. However, they are checked and cleaned every five days.

Lubrication schedules have been established for all equipment, and adherence to these schedules is checked through the written reports that must be turned in by the oilers. It has been the experience of this plant that whenever lubrication of equipment is slighted that fact soon shows up as repair charges on the record cards. Hence no chances are taken. In addition to being lubricated promptly on schedule, and checked practically every day just to make sure that everything is all right, every bearing is cleaned out and relubricated once a year.

As a check on their activities, the millwright, belt man, and oilers report daily to the plant engineer. If these reports indicate that a machine or piece of equipment is needing an unusual amount of attention, an investigation is promptly made. If any equipment is being neglected, that fact will be apparent from the reports and the reasons for it are sought at once.

Finally, the plant engineer goes through every department once a day and makes a quick inspection of power drives and other equipment to satisfy himself that they are operating properly. If he spots anything that needs attention, the millwright or other workman responsible is notified and action is taken immediately.

## Motors and Controls—*Gardner-Denver*

There are about 500 motors ranging from 5 to 200 horsepower, in addition to a number of fractional-horsepower machines, at Gardner-Denver Company, Quincy, Ill. Most of these motors are subjected to considerable dirt, and to cast-iron dust in particular.

All motors and controls are regularly inspected. Results are recorded. Dates of inspections and tests are also recorded on a card in the equipment file. These equipment cards carry all essential data for each motor. To make sure that no motor is being overlooked or neglected, the cards are examined at intervals. If the card for a certain motor shows that more than the prescribed period has elapsed since the last inspection, the motor is given attention immediately.

On motor inspection, particular attention is paid to cleanliness, airgap, and insulation resistance to ground. Large motors are cleaned by suction. Motors small enough to be handled conveniently are taken to the repair shop and washed out with lead-free gasoline.

If a motor shows an insulation resistance to ground of less than 25 megohms, it is removed to the repair shop, cleaned, dipped in insulating varnish, and baked. Every two weeks a full-fledged electrician inspects all motors to determine the need for lubrication. As with the inspection and repair work, the electrician reports in writing the date when each motor was lubricated.

Maintenance of electrical controls is also on a definite schedule. Contacts in line starters are inspected for burning. Other parts are looked over for whatever defects may develop. Every control in the plant is given a thorough going over once a year, sometimes oftener. All overload relays are checked yearly.

## Fluorescent Lighting—*Allis-Chalmers*

Maintenance schedules at Allis-Chalmers Manufacturing Company, Milwaukee, have been tailored to fit one plant with 3500 fluorescent lamps, and another with 15,000 lamps. A higher percentage of lamps used for shop lighting, as well as constant

**Portable workbench at J. I. Case contains all the tools maintenance men are likely to need on an ordinary repair job**

three-shift operation in the larger plant, emphasizes the allowances that must be made for differences in the size of installations.

A simple procedure of replacing burned out lamps is therefore followed in the smaller plant, while in the larger one a systematic replacement of lamps is made section by section at the end of the nominal length of life, even though most of the lamps still have some life left. In the smaller plant, it is possible for one electrician, with a replacement on second and third shifts, to keep a regular check on the condition of all the plant's fluorescent lighting.

In the larger plant, however, it has been proved that systematic lamp replacement by a larger crew is as satisfactory as the individual maintenance coverage in the smaller factory. This crew is made up of an electrician, or electrician's apprentice, and one or two common laborers who clean fixtures.

Keeping fixtures and lamps clean requires unskilled labor only, but has been found to be perhaps the most important consideration in lighting maintenance. Lamps can be burned beyond rated life, or individual lamps may be burned out, without seriously lowering the lighting efficiency in a given area, but lamps that are allowed to get dirty lose efficiency rapidly, and with a group of fixtures the overall lighting efficiency is appreciably affected.

In the smaller plant, lamps are cleaned three or four times a year. Until recently, in the larger plant, lamps and fixtures were cleaned only at the time of lamp replacement. By washing them once between replacements, however, efficiency is now being brought up about 15 percent.

Use of an adjustable platform ladder makes maintenance easy. Sockets are checked to insure good contacts and preclude the possibility of lamps falling out because of vibration. Ballasts and wiring also are inspected. Under good conditions cleaning can be done satisfactorily with a dry cloth, but in areas where oil and dust are prevalent, a liquid soap is preferred.

One plant turns off its fluorescent lights during the lunch hour and on idle shifts; the others operate continuously 24 hours a day. Despite the opportunity to compare the results, it is difficult to determine from the records which procedure is the more economical.

Lamps removed before they are burned out, as in the larger plant, are not taken out of service completely, but are used in areas where high intensity is not required.

One of the biggest maintenance problems, where new war plants are concerned, is how to arrive at a staggered replacement schedule. Starting with new lamps, a replacement peak naturally is reached sometimes later, when the majority of lamps will burn out over a relatively short period. Then an unusually heavy burden is placed on the maintenance men. With the system used by the smaller Allis-Chalmers plant, this peak would recur regularly, although it would spread out more and more each time, until sometime in the future a desirable staggering would be obtained.

In the large plant, where the mass replacement system is in use, a plan for replacement was begun after about a third of the original lamp life was gone. Then, by the shifting of groups of lamps, the remaining life in the first lamps replaced was used in those groups that were replaced later in the program.

## Prevention of Steam and Air Leaks—*J. I. Case*

In a plant that was started more than one hundred years ago, the problem of servicing air and steam lines under wartime conditions was met by making small but effective changes in routine. The plant is that of J. I. Case Company, Racine, Wis.

Air and water leaks had been checked every other Sunday for years; a whole crew of men went through all the buildings in a few hours. Now

two men take 7 hours to cover the plant. They work the larger buildings together and the smaller ones separately, which is the most effective method of getting the work done quickly.

Forty miles of airline varying from ¼ to 8 inches in diameter and carrying 100 pounds of pressure is used in the main works section. Two air compressors, one of 3000-cu.ft. capacity, steam-driven, and the other a motor-driven unit of 500-cu.ft. capacity, supply the air to operate several hundred air tools such as hammers, chisels, riveters, and speed wrenches.

Since the plant operates full time during the week, the only time when air leaks can be heard is on Sunday, when the buildings are quiet. All air valves in the plant are inspected at this time and necessary repairs are made immediately.

More than 30,000 feet of steamline between ⅜- and 20-in. size is used in the main works. About 70,000 pounds of live steam per hour at 150 pounds pressure is used for process work, of which 50,000 pounds is used by the forge shop. Exhaust steam is returned to the power plant and used at 2 pounds to run a low-pressure turbo-generator unit which generates approximately 75 percent of the electrical load of the plant. Surplus 2-lb. steam is used for heating.

Steam leaks can be noticed and repaired immediately, of course, but in the 2-lb. lines from the forge shop there are considerable grease and packing materials from the hammers. These materials are removed by three separators in the shop. All separators are cleaned every three weeks; the six most critical exhaust traps are inspected and cleaned daily. Others are cleaned when necessary, depending upon location.

When the labor shortage became noticeably acute, loss of time in making inspections and repairs became a serious problem. Formerly, when an inspector found something that needed attention, he had to come back to the shop to get repair tools and necessary materials, and then return to make the repair. To prevent this waste of time a portable maintenance workbench was devised which contains tools for cutting, threading, and doing any other pipefitting work, as well as enough pipe for any normal repair job. Legs that can be let down make the benches more rigid. Two have been put at the disposal of the eight steamfitters, and two others given to the seven electricians.

**Brick room adjacent to machine shop floor is used for oil storage at the Woodward Governor Company. Color code is a big help**

## Oil Conservation—*Woodward Governor*

Oil is stored in a brick room adjacent to the machine shop floor at Woodward Governor Company, Rockford, Ill. Twenty-two 500-gal. steel drums are mounted in two rows on steel frames. The bottom of the lower row is 4 feet from the floor. Some of the drums are divided into two compartments to provide storage space for oils used in smaller quantities.

Drums are filled by means of portable pumps, and emptied by spigots that are placed along the lower row and connected to the drums by a piping system. Each spigot is painted a color that corresponds to a code used throughout the shop. Each drum is also labeled.

All drums are equipped with float indicators, which indicate the level of the oil.

To guard against fire, the oil storage room is kept clean and free from debris. It is protected by a sprinkler system and extinguishers. Fire blankets are provided to protect personnel.

There is a grille in the floor in front of the door leading from the oil storage room to the shop. In a fire or accident, oil that otherwise might run into the shop would drain through the grille and into a pipe that runs beneath the floor, and be discharged outside the plant.

To conserve cutting oils, as well as materials, bins for chips have been built into the wall at one end of the machine shop. Each bin is marked, and great care is taken to see that chips from machines using a certain type of oil are put into the proper bin. The oil drains into tanks in the basement where centrifuge and a purifier reclaim the oil. Where several oils are used on a machine, the reclaimed mixture is used for fuel.

## One-Man Lubrication Plan—*Johnson Wax*

Making one man responsible for lubricating all the machinery in the plant of S. C. Johnson & Son, Inc., Racine, Wis., has not only reduced maintenance time, but has also in-

creased the efficiency and life of the machinery.

For many years the lubrication of machinery was left up to the operators in the individual departments in which the equipment was located. This was a carry-over from the days when the number of machines was so small that it was an easy matter for a foreman to check up on the units in his department. It was easy, however, to overlook machinery in out-of-the-way places, and when departments were pushed to the utmost to meet production schedules, and frequent lubrication was more necessary because of longer hours of machine operation, equipment was likely to be neglected.

The number of equipment items has now increased to over 700, driven by 550 motors ranging up to 50 horsepower. There are 175 pumps of various sizes, the rest of the equipment consisting mainly of agitated vessels, paint mills, filling machinery, an air compressor, and approximately 3000 feet of belt conveyor.

The first step in eliminating the guesswork was to give one man full responsibility for all lubrication.

A chart was prepared, listing machinery by buildings. Opposite each item are noted lubricants to be used, frequency with which the machine is to be checked, and time between flushings. The chart is mounted on a hand truck containing necessary lubricants and tools. The chart also contains space to check off each machine as it is lubricated.

Each machine has a tag. On one side are noted dates of flushing; on the other, dates when lubricants are added and amount added each time. In this way excessive consumption can be noted and investigated.

Keeping track of the lubrication of each machine has been particularly desirable under present conditions, because there is a great deal of shifting of equipment from one building to another. Sometimes the move is temporary, and the records of machine location may not catch up with it before the machine is moved again, but there is never any doubt as to when it was last lubricated.

## Cranes and Hoists—*Westinghouse*

In a large plant, with about 260 overhead electric cranes and more than 420 electric hoists in operation, crane inspection is extremely important. Prompt repairs, however minor, often prevent major breakdowns and reduce maintenance costs.

In the East Pittsburgh works of Westinghouse Electric & Manufacturing Company, there is a full-time crane inspection department, whose primary concern is safety. In making his report, an inspector examines traveling cranes, hoists, crane runways, trolley wires, load cables, and chains. Copies of his reports are kept on file for reference by the State Department of Labor & Industry. The inspector also authorizes corrections to be made, checks repairs when made, and inspects all new crane installations and major repair jobs.

Each part of the crane or hoist is inspected in the order shown on the report. When inspection is completed, defects are noted and later incorporated in the official report. A serious defect is immediately reported by phone; if conditions warrant, a defective-apparatus tag is attached to the crane. This tag can be removed only by the inspector after repairs have been made to his satisfaction.

First stop on an inspection trip is at the cage. The inspector looks for loose bolts, and for cracked castings and wheel spokes. The master switches, control panel, and resistors are next checked. The bridge is run up and down the aisle to note any fault. This operation sometimes uncovers a twisting motion, usually caused by uneven wheel wear.

Continuing from this point the inspector checks trolley, collector slides, overtravel limit switches, and accelerating relays. Some minor adjustments are made by the inspector.

Careful examination is made of the hoisting cable. Sound judgment is needed in order to get maximum cable life and still maintain a good safety factor. When a cable is 40 percent worn, or has three or more wires broken in each strand, it is replaced. Hook bearing and block sheaves are inspected at the same time.

First to be inspected on the bridge is the motor. Its temperature is noted, and the commutator, brushes, and armature bearings are examined for wear. Bearings on hoist and trolley

**One man at S. C. Johnson & Son is responsible for lubrication of all machinery. He has a chart that lists machinery by buildings, and a hand truck to carry all necessary lubricants and tools**

motors are inspected, as are line-shaft bearings and track wheels.

On the hoist, the motor is inspected thoroughly. Special attention is paid to the commutator, since a dirty commutator impairs the effectiveness of dynamic braking.

Electric brakes are checked carefully, because settings must be exact for proper action.

After the inspector finishes his detailed inspection, he makes a survey of cleanliness. Before passing to the next crane he notes mechanical and electrical defects found, to serve as a basis for his report.

The report is made out in triplicate, and each defect with approximate repair cost is written down. Original and one carbon copy are sent to the supervisor of maintenance in the department involved. The supervisor retains the carbon copy for his file, approves the expense on the original copy, and sends it to the crane repair department to authorize repairs to be made. When the work is completed, the original is returned to the inspector, who checks and approves repairs. The third copy is kept on file by the inspector.

**Safety is naturally the primary concern of the full-time crane inspection department at Westinghouse East Pittsburgh works**

## ELECTRIC AND GAS-ELECTRIC TRUCK MAINTENANCE REPORT

DATE _____ REPORT BY _____

TRUCK NO. _____ IN GARAGE _____ AM PM

MAKE _____ OUT _____ AM PM

*LUBRICATE* (according to mfg. recommendations) _____ # Lubricant _____

*DRIVING UNIT:* Universal joints ____ Leatherboots ____ Axle yokes ____ Wheels ____
Tires ____ Torque link bushings ____ Brake adjustment ____ Motor brushes ____ Oil level ____

*HOISTING UNIT:* Brake adjustment ____ Motor brushes ____ Oil level ____
Oil pump ____ Oil piping ____ Cables ____ Chains ____

*AUXILIARY OR TILTING UNIT:* Brake adjustment ____ Motor brushes ____ Oil level ____

*ELECTRIC CONTROLLERS:* Drive ____ Hoist ____ Tilt ____ Sluing ____ Revolving ____ Steering ____
Horn ____ Lights ____ Power steer ____ Blow with air and clean with cloth ____ File contacts smooth and lubricate with vaseline ____ Check for loose connections ____

*OPERATOR PLATFORM:* Pedal adjustment ____ Steering wheel or lever ____
control handles ____

*TRAILING WHEELS:* Wheels ____ Tires ____

*LOAD PLATFORM OR FORK CARRIAGE:* Chain adjustment ____ Platform or carriage adjustment ____

*GENERAL:* Limit rods and levers ____ Steering rods and connections ____ Lubrication ____

*MOTORS:* Blown out ____ Commutator ____ Check for roughness ____
Check for short brushes ____ Do they work freely in holders ____

*SWITCHES:* Check to see that power does not go on until brake is released and off when brake goes on ____

*WIRING:* Insulation free from grease and oil ____

*PLUGS AND RECEPTACLES:* Contacts rough or burned ____ Secure to truck ____

*BATTERIES:* Check connections between cells ____ Steam and clean ____
Check for metal objects between cells ____

*HOUSED GEARS:* (Inspect quarterly) Gears ____ Gear bearings ____ Differential ____

ELECTRICIANS RING CARDS FOR BATTERY CHARGING AND EACH MAN TO TURN IN HIS CARDS WITH NAME SIGNED

Remarks ____

**Industrial trucks at Corning Glass works are scheduled for periodic inspection, and for regular greasing and maintenance. When the truck comes in, the mechanic checks it over, item by item**

## Industrial Trucks— *Corning Glass*

To get every last minute of usage out of existing industrial truck equipment, Corning Glass Works, Corning, N. Y., finds it is necessary (1) to have no idle time during the hours the trucks are available, and (2) to make trucks available for as many hours as possible by periodic maintenance.

To minimize idle time, a recorder has been installed on each truck. This gives a round-the-clock picture of running time, so that operation can be analyzed.

The first requirement of maintenance and service is that the batteries be charged at regular intervals, and properly changed and serviced. For battery charges, the truck mechanic rings a job clock card when the truck goes on charge and rings the card a second time when it comes off, signing his name and the truck number. This card therefore records charging time, and comparison of the cards for the same truck shows whether charges are being given regularly. The mechanic

also notes on the same card whatever maintenance attention is given the battery.

Next, each truck must be scheduled for regular greasing and maintenance (see schedule on page 183). Each truck must be available for service at the time and date specified.

The truck mechanic marks the *Time In* and *Time Out* in the open space opposite the truck number for that week. When the truck comes in he checks the entire truck, item by item, and shows what periodic inspection and repairs are made.

## Care of Machine Tools by Older Men—*Sly*

In setting up a program for preventive maintenance at The W. W. Sly Manufacturing Company, Cleveland, it was found that the most important single factor to be considered is the human element. It soon becomes evident in any survey of breakdowns that in the majority of instances these breakdowns have been due to action or lack of action on the part of the operator, a lack of knowledge of his machine, or a disregard for company property. The condition of a machine is a direct reflection of the operator's attitude toward the machine. If no attempt is made to influence that attitude favorably, the operator can hardly be held responsible for machine failure.

Basically, a man operating a piece of equipment does a better job if he has an attitude of pride and respect for his equipment. In order to have this feeling, he must thoroughly understand the machine with which he is working. Not only must he understand how to operate it, but he must know also what makes it operate, its capacity, speed, lubrication, and how to set it up properly. He should, in a sense, feel a sort of friendship for the machine, instead of regarding it as just a means of making a living.

If this attitude can be induced, it will reduce high maintenance costs and lost productive time that result from the poorly informed employee and the influx of new employees, many of whom are totally unaware of the need to care for their equipment or of the difficulties management has in replacing broken equipment.

There are some old employees at the Sly plant who feel that way about their equipment. They have operated their machines for an aggregate of a good many years and have developed an attitude of almost loving care and attention towards them. They know their individual machines so well that they are able to tell by feel and sound when they are operating smoothly, and thus they avoid the stresses and strains of overloading that lead to breakdown. They conduct periodic inspections and follow a rigid routine of lubrication from force of habit. Their machines are the source of less maintenance, downtime, and expense than any of the remainder of the equipment in the plant.

There is, for example, a set of power-driven pyramid rolls that has been in operation under one man for 30 years and has been down for repairs only three times. A 10-ft. press brake in operation 15 years under the same operator, and an openside planer in operation for 18 years under one man, have never been down for repairs.

The low maintenance cost on this equipment, which is in constant operation, is due almost entirely to the feeling of the operator for his machine.

The management therefore decided to try to imbue other employees with the same knowledge of, and attitude toward, their machines. To begin with, the older men were publicized to the rest of the employees as having the proper relationship between man and machine. Their methods were cited as exemplary, and the other men were urged to follow in their footsteps and to ask advice from them.

Every effort has been made to familiarize each new man with his machine, be it large or small, from the standpoint of design, operation, capacity, and speed. Ample lubrication facilities are placed at his disposal, and an inspection and lubrication routine is recommended.

If there is a breakdown, the operator is allowed to participate, when possible, in the repairing of the equipment, in order to familiarize him further with the machine. Above all, the operator is impressed with the fact that the entire responsibility for the equipment rests on his shoulders, and that any breakdown must be accounted for. He is told the machine will give him the same kind of treatment he gives it.

For the most part the men are taking a marked interest in the program because it tends to satisfy their natural mechanical curiosity. Also, they have developed a sense of responsibility that was heretofore non-existent.

If the present trend continues, maintenance requirements will be considerably less than formerly. Most important, the loss of productive time from breakdowns will be diminished. The program is now paying dividends that will grow as the operator's respect for, and pride in, his equipment increases.

## Lubrication of Machine Tools—*Bausch & Lomb*

The most important step toward putting lubrication on a sound footing Bausch & Lomb Optical Company Rochester, was the appointment of one man to coordinate the work. One of the major oil company's lubrication engineers was called in to assist in charting machines and to advise as to the correct lubricants needed.

**1. Circulating Oils.** The oils employed for this service are called on to perform satisfactorily over long periods of time as fluid media in hydraulic systems; as a lubricant in circulating systems to gears and bearings as a lubricant in crankcases of refrigeration and air compressors; and as a gear lubricant in the reducing mechanisms of some machine tools.

**2. Spindle Oils.** Spindles in this plant are of two varieties—high-speed shafts actuating precision tools, and moderate- to slow-speed shafts.

**3. General Purpose Lubricants.** These are applied to miscellaneous bearings and moving parts by oil can, oil cup, oiling devices, force-feed lubricators, and one-shot systems.

**4. Gear Oils.** It has been found that only three gear lubricants are necessary for inclosed gearcases.

**5. Lubricant for Bearings.** A few ball and roller bearings are lubricated with oil, the remainder with grease. Grease-lubricated antifriction bearings are found both in places where they can be identified as such, and also where positive identification is difficult.

**6. Special Lubricants.** There are a few conditions for which none of the conventional lubricants mentioned previously would be completely satisfactory. These isolated applications require special lubricants.

After the proper lubricants had been selected, a new method of designating application periods was developed. All lubricants were distinguished by a color, and all fittings were painted to correspond with the lubricant to be used. The next step was to map a daily route and a schedule.

With this system, a new man can be taken into a department and told to put the oil from a red drum into a red can, and then into all red holes. Machines can then be lubricated properly with the minimum of confusion and opportunities for errors. It had been found that after a man has familiarized himself with this method he can lubricate twice as many machines as formerly.

# *Without batteries*...war machines are useless!

1. Bomber 2. Destroyer 3. Submarine 4. Landing Barges 5. Troop Transport Trucks 6. Supply Trucks 7. Self-propelled 155 mm. Gun 8. Tanks 9. Jeep 10. "Walkie-talkie" Communications

Modern mechanized warfare demands a dependable source of electric power, which, under most conditions, only a storage battery can supply. Our mightiest weapons would lie useless, idle, dead, without such a source of power.

On every fighting front, on land, at sea, and in the air, Exide Batteries are filling this important role. Exide Batteries are used in over 100 applications by our armed forces. Significant of our part in the war effort are the Army-Navy "E" pennants, with two stars, that fly over our plants in Philadelphia.

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THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia • Exide Batteries of Canada, Limited, Toronto

# NEW Catalogue

## *Self-Lubricating* BRONZE BEARINGS

**This new book will save you time, trouble and money when ordering self-lubricating bushings or bearings. Thirty-six pages filled with useful, informative data will help you to accurately determine your needs. A complete listing of over 2000 individual sizes . . . including plain, flanged and spherical bearings . . . will help you design to standards thereby eliminating delay and die expense.**

**Competitive tests in practically every type of industry have definitely proven the superiority of Johnson Bronze LEDALOYL. Our exclusive process of PRE-ALLOYING the basic materials provides bearing qualities not obtainable by any other method.**

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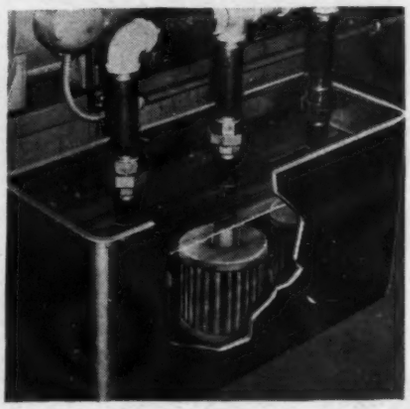
*Specify* JOHNSON BRONZE


# WHAT'S NEW IN EQUIPMENT

## Sump-Type Liquid Filter

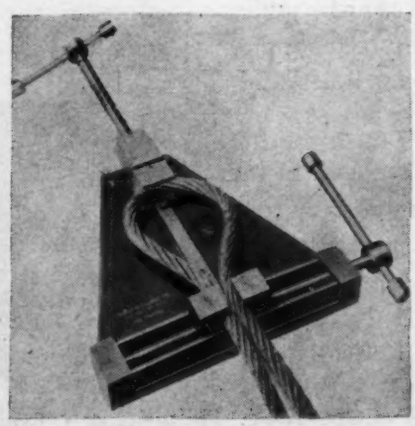
Designed for use wherever dirty liquids are collected, filtered, and recirculated, Model SE sump filter's radial fin insert provides an effective filtering area in a minimum of space. The filter unit can be mounted on the end of pump suction lines and completely submerged in the



settling basin or sump from which the pump obtains its liquid. The unit may be dismantled without removing it from the pump suction line. The filter consists of four major parts: An upper end plate mounting a threaded sleeve outlet connection; a perforated metal central supporting tube on which is mounted the filter insert; a heavy corrugated metal screen to supply strength and rigidity, over which slides the pre-formed filter insert; and a lower end plate. A wingnut holds the entire assembly together. The radial fin insert can be expanded like a bellows for quick cleaning. Staynew Filter Corp., 11 Centre Pk., Rochester, N. Y

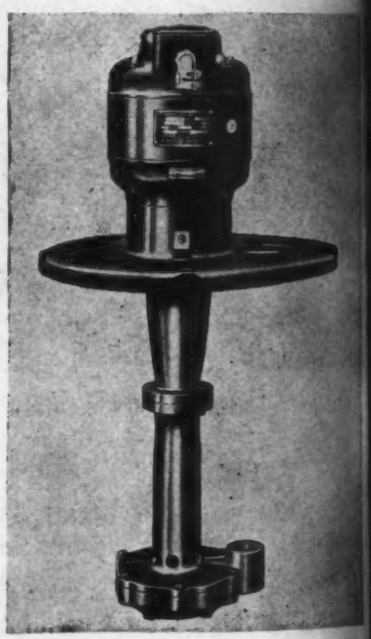
## Portable Forming Vise

Portable rigger's forming vise that handles wire, rope, and cable from $\frac{3}{8}$- to $1\frac{1}{4}$-in. diameter without adapters has been developed. Splicing and clamping operations, as well as the forming of cable into an eye around a thimble, are easily handled. It is the result of a design for screw and levers which, according to the manufacturer, gives complete, easy jaw and [illegible] control. The vise is equipped with [illegible] to protect against cable and thread [illegible] tion. It is built to withstand the [illegible] and strain of heavy cable, weighs about [illegible] pounds, and has a 15x14-in. base. Patrick-McDermott & Co., 1645 E. [illegible] St., Los Angeles.



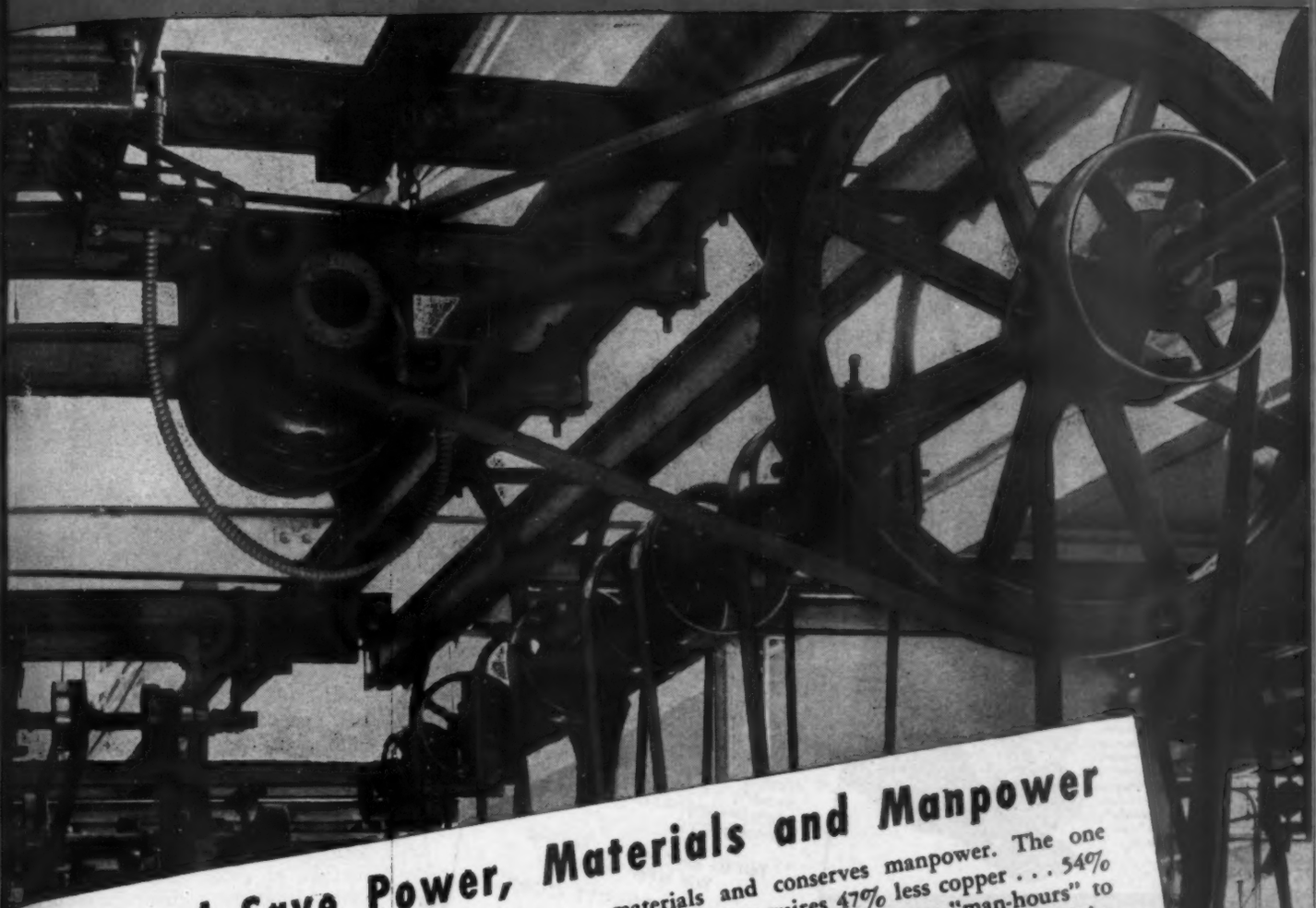
## Coolant Pump

Designed for deeper immersion, vertical gusher coolant pump Model TL is claimed capable of handling soluble coolants containing grit and abrasives without injury to the mechanism. The unit is provided with an integral mounting flange which is usually bolted to the reservoir cover or base plate, and forms a simplified installation in connection with a comparatively deep reservoir. No packing glands or friction seals are used; there are no bearings or metal-to-metal contacts below the mounting flange. The shaft, which rotates on two large ball bearings, is of one-piece construction



and extends from the motor through the tubular housing to the pump impeller. One ball bearing is mounted in the upper motor end bell, and the other within the mounting flange housing. The weight and thrust of the vertical shaft is taken by the large lower ball bearing which is locked into position. This eliminates any change in the position of the pump impeller both before and after the motor reaches its normal operating temperature. Available in two lengths: $23\frac{5}{8}$ and $19\frac{5}{8}$ inches. Comes equipped with $\frac{1}{2}$-hp. totally [illegible]

# How To Make *One* Motor Do The Work of Several



## . . . and Save Power, Materials and Manpower

A Modern Group Drive with Leather Belting permits one motor to do the work of the several smaller motors required for individual drives. In the average factory, this reduces connected horsepower 25% to 45% . . . because, with individual drives, the motors must be large enough to carry the peak load of each machine, while the motor for a Modern Group Drive need be only large enough to carry the *average* load of the entire group. This is usually less than two-thirds of the total peak loads of the individual machines.

For instance, if six machines each require a 10-horsepower motor for individual drives, all six could be driven by one 40-horsepower motor with Modern Group Drive and Leather Belting. This not only reduces power consumption and cost, but also saves large quantities of critical materials and conserves manpower. The one large motor requires 47% less copper . . . 54% less steel . . . and 70% fewer "man-hours" to build . . . than the six smaller motors. Maintenance, too, is cut down 33% to 50% . . . because a Modern Group Drive with Leather Belting always involves fewer parts and controls than individual drives for the same number of machines.

Leather Belting used on Modern Group Drives is playing an increasingly important part in helping Industry to "produce the most with the least." Any Leather Belting supplier will give you complete information. Also ask him for a copy of the useful booklet, "How To Get The Most From Your Leather Belting." Or write to

**AMERICAN LEATHER BELTING ASSOCIATION**
53 Park Row, New York, N. Y.

*Rely on Leather Belting*

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INSTANTLY Federal Indicator Gages tell you not only whether right or wrong . . but how much. Tell you so clearly and positively no eye can miss.
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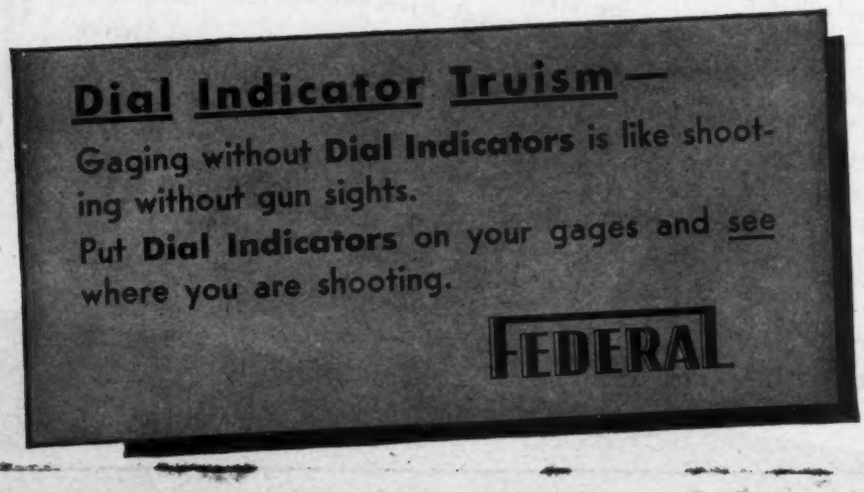
PRECISION MEASURING INSTRUMENTS


Dial Indicator Truism—
Gaging without Dial Indicators is like shooting without gun sights.
Put Dial Indicators on your gages and see where you are shooting.
FEDERAL

closed motor for continuous duty or a ¾-hp. motor for extra-heavy duty. The Ruthman Machinery Co., 1810 Reading Rd., Cincinnati, Ohio.

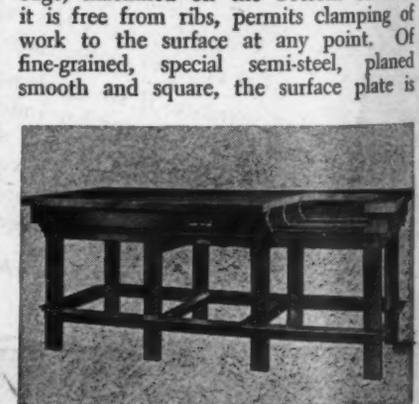
## Direct Current Vertical Motors

Line of d.c. vertical motors ranging from 40 to 200 horsepower at 1750 r.p.m., and in equivalent ratings at other speeds, has been announced. The motors, which are furnished for both constant and adjustable speeds, are designed for low-thrust, solid-shaft applications on pumps and machine tools. They are of drip-proof, protected

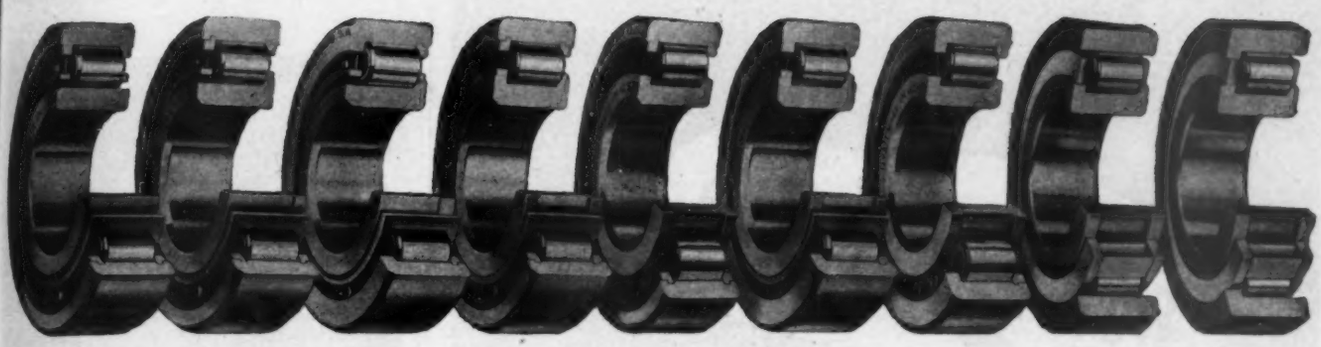
construction. Convenient fittings on both the upper and lower bearings simplify lubrication, and provision for the escape of excessive grease reduces the possibility of over-lubrication. A special bearing housing prevents grease from entering the motor. Cast-iron conduit box can be arranged for bringing leads in at the top, bottom, or either side. Two handhole covers, removable without the use of tools, permit easy inspection of the commutator end brushes. Ring-type base has an accurately machined rabbet and jig-drilled mounting holes, assuring permanent alignment with the driven machine. General Electric Co., Schenectady.

## Layout Plate

The surface of this layout plate has overhanging edges on all four sides. The edge, machined on the bottom so that it is free from ribs, permits clamping of work to the surface at any point. Of fine-grained, special semi-steel, planed smooth and square, the surface plate is



# HYATT HAS THE ANSWERS



A-TS R-TS R-YS U-TS U-TM U-YS U-YM BU-Z BU-L

## TO ALL YOUR RADIAL BEARING PROBLEMS

### ...With 9 Different Types of Hy-Load Bearings.

In light and medium series, narrow and wide widths. Made to American Standards Association boundary dimensions—and to Hyatt standards of quality. The check list below shows how Hyatt Hy-Loads can solve radial bearing problems for you. For further information, write for Bulletin 541A.

**A-TS** For shafts of fixed location, carrying torsional and radial loads only.

**R-TS** Same as above, but with one flange on the inner race.

**R-YS** Where bearing is required to take light or intermittent thrust loads and locate the shaft in one direction. Has flange on inner and outer race.

**U-TS** Where application has no provision to retain the outer race endwise, or where bearing must be assembled as a unit.

**U-TM** For additional capacity on slow speed applications. Similar to U-TS, but separator is omitted to allow maximum number of rollers.

**U-YS** When bearing must be assembled as a complete unit, and sustain light thrust or locate shaft in one direction.

**U-YM** For additional capacity on slow speed applications. Similar to U-YS, but separator is omitted to allow maximum number of rollers.

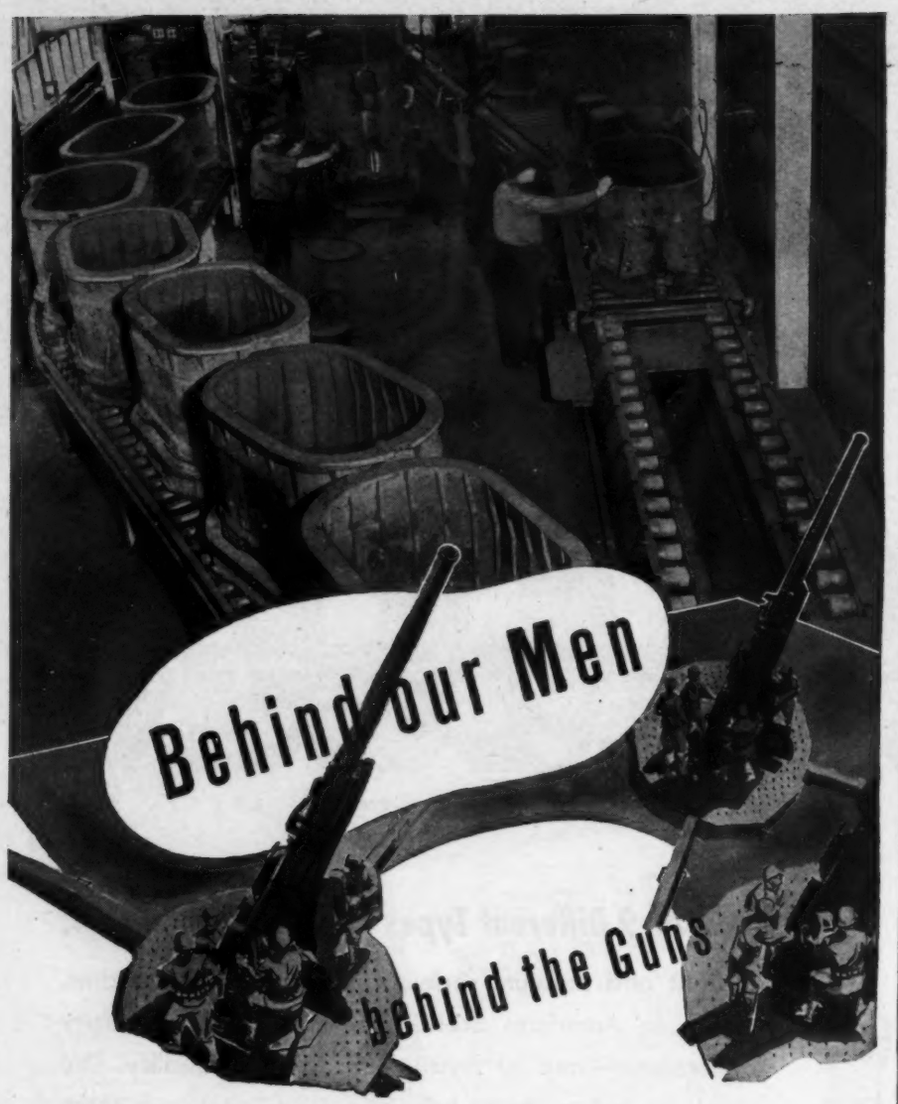
**BU-Z** Where mounting conditions require that the roller and inner race assembly be kept with the shaft.

**BU-L** Where bearing must also locate the shaft or sustain light thrust loads in one direction.

*Clip This Ad for Your Bearing Information File*

# HYATT ROLLER BEARINGS

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, N. J.

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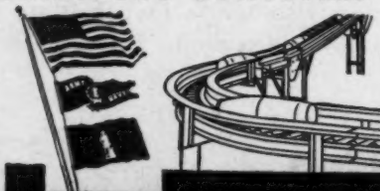
There's no surer way to shorten the war . . . no surer way to save the lives of our fighting men . . . no surer way to save our American way of life.

Speeding up assembly . . . removing production bottlenecks . . . preventing hitches in the speeding movement of vital war materials is Mathews' contribution to America's war effort.

**MATHEWS CONVEYERS FOR MECHANIZED PRODUCTION**



If you are manufacturing war material, or anything vital to the success of the war effort, you can get Mathews Conveyers to handle that material. Rely as usual on your Mathews Engineer.

MATHEWS CONVEYER COMPANY ELLWOOD CITY PENNSYLVANIA

mounted on an all-steel base. Equipped with lock leveling screws (the number of screws varies from 28 to 40 according to the size of the plate), work can be clamped into place quickly and securely. Made in four standard sizes: 36x72, 40x96, 48x96, and 48x128 inches. The Challenge Machinery Co., Grand Haven, Mich.

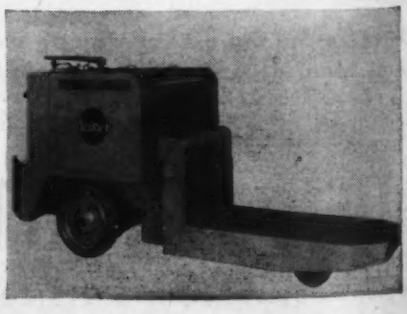
## Precision Switch

The Peanut switch is no bigger than the end of a man's index finger, but, according to the maker, is more rugged and more resistant to vibrations than larger models. Having a high electrical rating, the Peanut is available with or without an inclosing case. When used without

the case, actuating movement can be applied anywhere over a large portion of the upper spring. A stem mounting is provided with the case. The construction provides inherent overtravel beyond the point of operation great enough for most uses. Has contact gaps up to 0.085 inch which can be varied in the manufacture. Contacts are of pure silver formed with a knurled surface to provide high unit contact pressure for low-voltage applications. Micro Switch Corp., Freeport, Ill.

## Low-Lift Truck

Built for long hours of continuous operation, Type E-2 low-lift truck has an extra large battery box to provide additional battery capacity. The front top corner of the battery compartment is chamfered to aid vision, and the cover is of the sliding type, equipped with handles. All controls, together with lift motor and pump, are in a convenient control panel. The travel brake, located below the panel, is adjusted by a single, easy-to-reach hex nut. The alloy-steel trailing axle is anchored to the

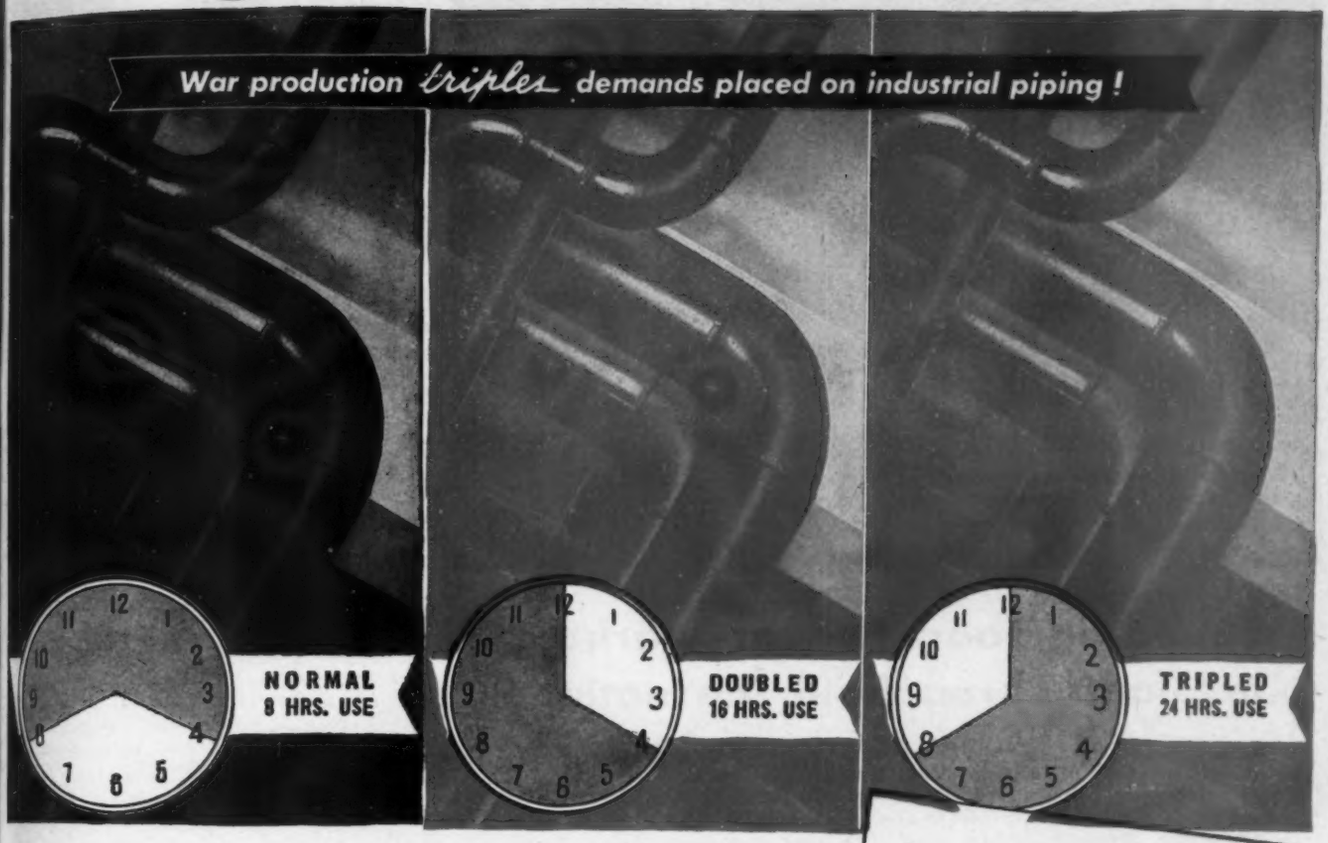


NO. 7 OF A SERIES

HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

# Welding with TUBE-TURN fittings gives extra strength and trouble-free performance needed today to insure uninterrupted piping service




'ROUND the clock, war-time operation for 24 hours a day instead of the normal 8 hours period *triples* the wear of oil, gas, power, chemical, heating, air, refrigeration and marine piping today.

Despite the extra strain that fittings naturally take, coupled with constant three-shift operation, Tube-Turn welding fittings are *practical insurance* against piping failures. Tube-Turn fittings are *stronger and safer* because of their exclusive construction advantages. They provide leakproof, trouble-free joints that last as long as the pipe itself. They can be installed faster and easier, can be quickly insulated, instantly eliminate maintenance worries, and provide streamlined, space-saving layouts.

Sizes, types and weights are available for every industrial requirement. *Write for catalog and data book No. 111.*

## OTHER IMPORTANT WAR-TIME ADVANTAGES:

**SPEED INSTALLATION:** Less time needed for aligning, thanks to true circularity and uniform walls. Only simple butt welds required, easy even for novice welders. Whole sections can be preassembled on the ground.

**SAVES CRITICAL MATERIAL:** Absence of many flanges, bolts, nuts and heavy cast steel construction saves many tons of metal in a single piping system.

**LAST LONGER:** Smooth inner walls—with no ridges, waves or scale—means less corrosion and longer life.

**LESS PRESSURE LOSS:** Because of full effective radius and exact O.D. and I.D. alignment with the pipe, the flow is more efficient and pressure loss is less.

**FEWER SUPPORTS NEEDED:** Since welded piping weighs less and stands vibration better than flanged systems, few hangers or supports are required.

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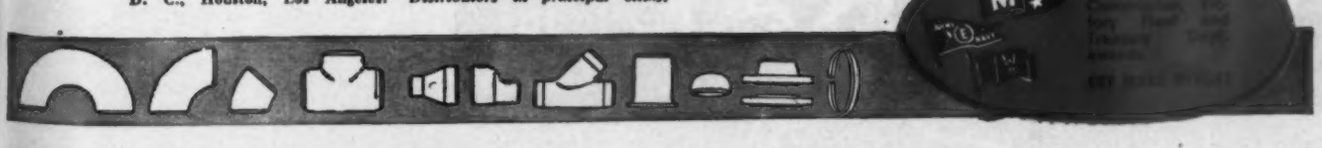
TRADE MARK

*Welding Fittings and Flanges*

TUBE TURNS (Inc.), Louisville, Ky. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, Los Angeles. *Distributors in principal cities.*



# GENERAL JUMBO JRS

*Ideal Outdoor Model*—Inset shows how Jumbo Jrs protect by *cushioning* load, floor and conveyance.

## Speeding food to war-workers in plants throughout the nation!

● Ideal Food Conveyor Systems made by the Swartzbaugh Manufacturing Company, Toledo, Ohio (pioneer builders of food transportation equipment since 1884) are helping feed war-workers in plants on the entire production front. Bringing them food to save valuable production time . . . avoid confusion, promote morale, save floor space and cut out food waste! Bringing food quickly . . . quietly . . . *safely* on General Jumbo Jrs —industrial pneumatic tire favorite.

This use of Generals on pneumatic-equipped Ideal models is added proof of Jumbo Jrs' extreme versatility. Added proof that no matter what the job . . . the General Jumbo Jr. *tire-tube-wheel* combination is the team to pick!

General Jumbo Jrs can *take it!* Cushioning loads . . . protecting load, floor and conveyance alike against damaging jolts and bumps! Jumbo Jr. is a safer industrial tire . . . its exclusive wide rim design assures extra stability. Traction is exceptional . . . the pneumatic principle resists picking up of filings, chips and clippings. Exclusive and patented, Jumbo Jrs' design makes possible service unequalled by any other industrial tire!

Tires 8" to 24" overall diameter. Load capacity 100 lbs. to 1500 lbs. per tire. 2-4-6 and 8-ply with separate tubes and heavy duty wheels.

*For further information write or call—*

THE GENERAL TIRE & RUBBER COMPANY
AKRON, OHIO

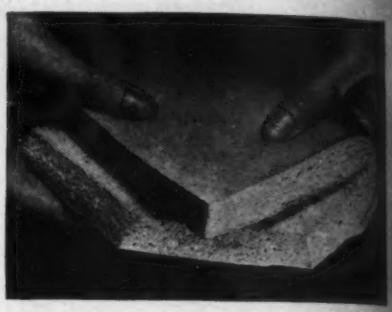
***Available in new Air Corps specification sizes. Also for war orders and certain essential industrial uses.***

GENERAL JUMBO JR.
INDUSTRIAL PNEUMATIC TIRES


frame, and the wheels steer on antifriction bearings. Built on a 66-in. wheelbase, with an over-all length of 123¾ inches, the truck can make right-angle turns in aisles 67 inches wide. Has a 4000-lb. capacity. Industrial Truck Div., The Baker-Raulang Co., 2168 W. 25th St., Cleveland.

## Substitute Rubber Sponge

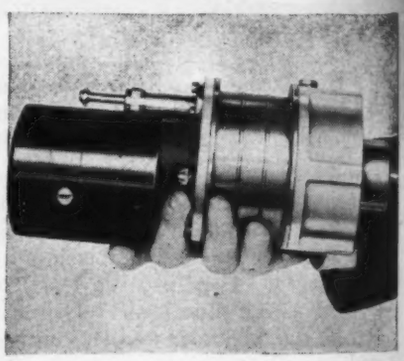
Koroseal sponge, made from plasticized polyvinyl chloride as a substitute for natural rubber sponge, is now available for essential industrial applications. Principal



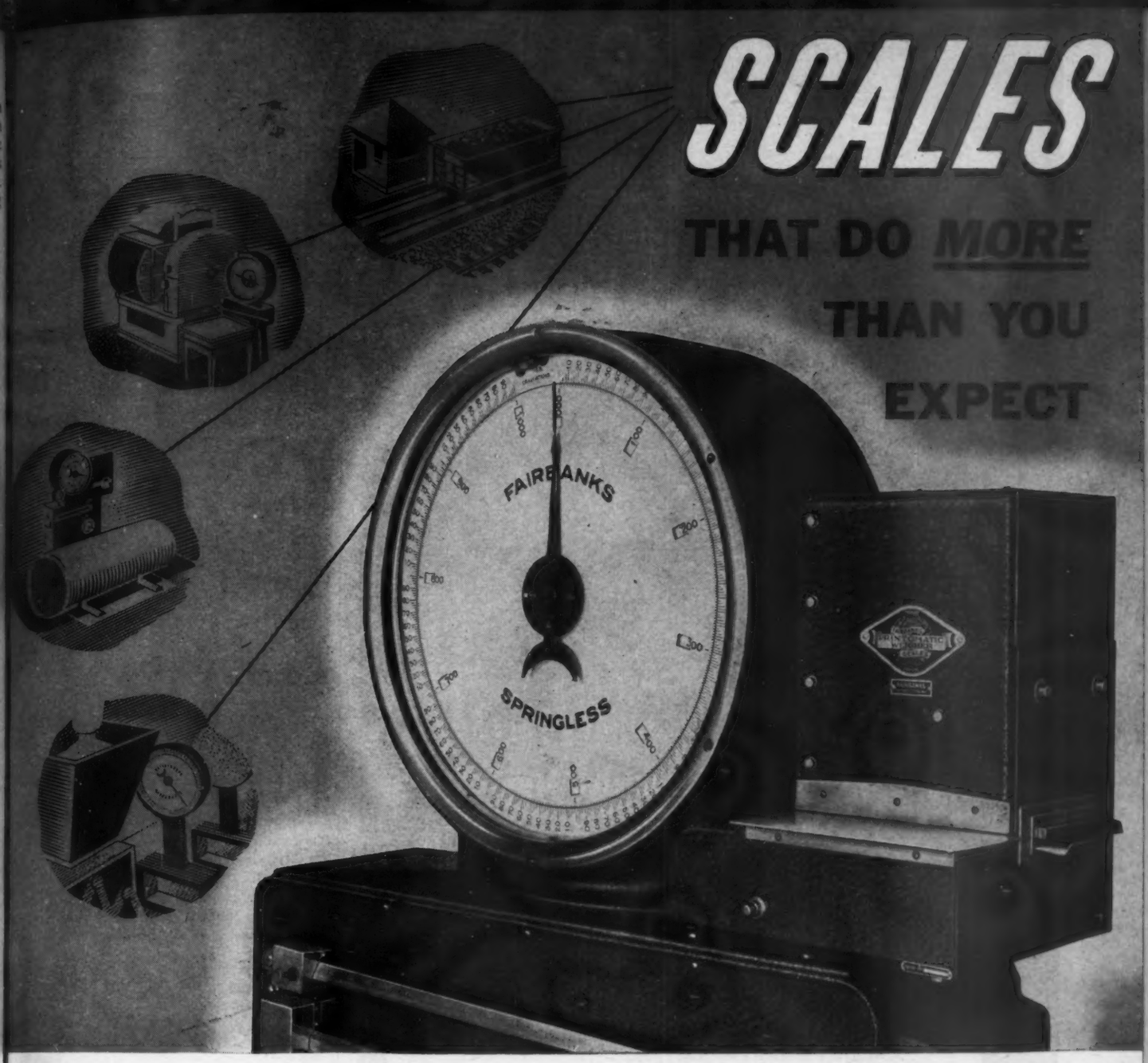
advantage of Koroseal sponge is its nonflammability even against an open flame. It is claimed to be resistant to oils, greases, chemicals, and oxidation. It can be made in various densities and pore sizes. The B. F. Goodrich Co., Akron, Ohio.

## Variable-Speed Drive

Weighing only 8 pounds complete with motor, midget Model 15 drive is recommended for uses requiring an accurate low-power variable-speed transmission of wide range. This unit, for use in the "flea power" range, is applied to motors



of not more than 1/15 horsepower. Torque ranges from 4 inch-pounds at maximum forward speed (for 3600 r.p.m.) to 8 inch-pounds in reverse; or from 1 inch-pound at maximum forward speed (for 1800 r.p.m. input) to 2 inch-pounds at reverse. Output speed range is from 700 r.p.m. to zero, or if it is desired to reverse the output shaft without reversing the motor, the range is from 400 r.p.m. forward to 400 r.p.m. reverse. Reversal is claimed instantaneous and shockless. The model is adaptable to lever control; to manual control by hand wheel with speed indicating dial located at either side of the unit; or other special control to suit individual application. Of all-metal construction, over-all length, in-




OF course, Fairbanks Scales are big, husky, and accurate. You have a right to expect these things in *any* good scale — and particularly of Fairbanks Scales with the world's broadest scale manufacturing experience behind them.

The feature about Fairbanks Scales that may surprise you the most, is their ability to do things you *don't* expect of scales.

Here are a few of many jobs done by Fairbanks Scales:

- They count small parts — more accurately than manual counting
- They weigh carloads of coal in motion and make a printed record of each weight
- They automatically control paint ingredients
- They automatically control aggregates
- They "keep the books" in steel plants, making printed records of incoming and outgoing shipments
- They keep accurate records on chlorination in water treatment
- They record the *flow* of liquid chemicals
- They guard secret formulas in compounding
- They control batching in bakeries
- They prevent disputes by eliminating the human element in weighing.

AND all of these things, only the beginning of the story, they do automatically and mechanically thereby eliminating human errors.

How Fairbanks Scales can be fitted into your production flow to speed up operations and eliminate errors may prove to be the most interesting discovery you ever made. Investigate now. Write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Illinois.

# FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
SCALES

WATER SYSTEMS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS
RAILROAD EQUIPMENT

FAIRBANKS SCALES

Scales

What's this Little Bostitch Staple doing on the "Graveyard Shift"?

**Making thousands of fastening jobs easier . . . so that operators can do their best on this most difficult of all shifts . . . so that less-skilled workers can be more quickly trained . . . so that other workers can be more easily stepped up to supervisory jobs.**

**Adding production *speed* . . . in steel-stitching parts for planes and tanks . . . in shaping ammunition belts . . . in packing and shipping . . . in hundreds of other applications newly created for war purposes . . . in thousands of applications regularly used on civilian products but now enrolled in war service!**

**These wartime uses are further evidences that "Bostitch fastens it better, and faster, with wire." Meeting war production challenges is also creating new and improved Bostitch tools and applications for future use. The unrivalled variety of Bostitch models and types makes possible the right combination of machine and staples for each particular job.**

**If you have the necessary priorities, find out *now* if Bostitching can help speed your production . . . if priorities are not available, investigate Bostitching *now* so that you can apply these advantages and improvements immediately to quick post-war adjustments and production. Bostitch (Boston Wire Stitcher Company) 63 Blackmore Street, East Greenwich, R. I. (Bostitch-Canada, Ltd., Montreal).**

**BOSTITCH**

*fastens it better, AND FASTER with wire*

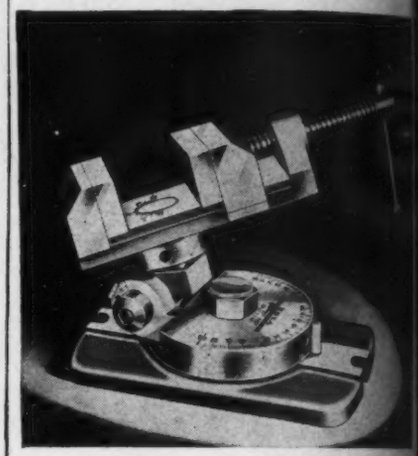
ALL TYPES OF STAPLES APPLIED BY MACHINES
ALL TYPES OF MACHINES FOR APPLYING STAPLES

One of the Bostitch time-savers

cluding input and output shaft extensions is $7\frac{5}{8}$ inches; depth with adjustable mounting legs is $4\frac{3}{8}$ inches; height from base to top of motor is $4\frac{7}{8}$ inches. Speed is closely held at any one setting without cyclic variation, and the drive returns to a pre-set speed with negligible error. Graham Transmissions, Inc., 2706 N. Teutonia Ave., Milwaukee 6.

## Vise

All-angle Driv-Wheel movement vise has three protractor dials for horizontal, vertical, and diagonal settings. Features include a drive wheel motion which gives a $2\frac{3}{4}$-in. lateral clearance; double swivel



construction which permits any horizontal position; right-angle clearance which allows perpendicular position without base obstruction; positive horizontal setting for 180-deg. accuracy. There are three sizes: $3\frac{1}{2}$, $4\frac{1}{2}$-, and 6-in. jaw widths. Berco Mfg. Co., 429 W. Superior St., Chicago.

## Fire Protection Pump

To give plant safety men a hand-operated pump of greater capacity and higher pressure than the so-called "stirrup pump," an adaptation of the standard barrel-mounted rotary hand pump has been developed for use as an auxiliary fire pump. Primarily

## Sure foot—steady aim!

When the alarm gong sounds "Battle Stations", the slightest slip may mean failure. That is why gun crews on America's "battle wagons" depend on "A.W." Rolled Steel Floor Plate. In vital war plants, refineries, power plants, railroads, "A.W." Floor Plate stops dangerous slipping and falling accidents. Toughest wear will not damage or impair it. Ends floor troubles for good. Write for folder.

*Other products include Plates, Sheets, Billets, Blooms, Slabs—Carbon, Copper or Alloy analyses.*

# ALAN WOOD STEEL COMPANY

MAIN OFFICE AND MILLS: CONSHOHOCKEN, PENNSYLVANIA : SINCE 1826. District Offices and Representatives: Philadelphia, New York, Boston, Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, St. Paul, New Orleans, Pittsburgh, Roanoke, Sanford, N. C., St. Louis, Los Angeles, San Francisco, Seattle, Montreal

MOUNTED WITH COOLING UNIT

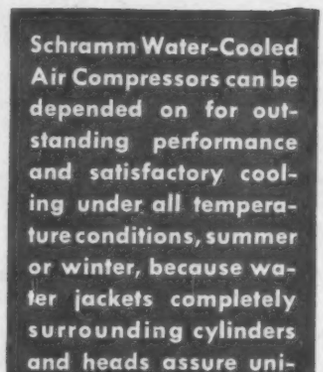
# JUST LAY IT ON THE FLOOR

## and hook up to current and air lines . . . . . .

In spite of the fact that the SCHRAMM Compressor unit shown above comprises motor, compressor and radiator, it actually is a "one-piece job". All are assembled rigidly and in perfect alignment on a substantial steel base which can serve as a vibrationless foundation. No belts, pulleys, flywheels or water connections are necessary.

**If it's a Schramm** you can pack a 600 cu. ft. per min. job into a space measuring only 90 ins. x 37 ins. Schramm's vertical, in-line design makes it a neat, compact package, for heavy and continuous service . . . Motor controls for the required starting current and torque can be furnished as a part of the unit or for remote installation . . . Sizes range from 50 to 600 cu. ft. displacement at 100 lbs. pressure.

Schramm Water-Cooled Air Compressors can be depended on for outstanding performance and satisfactory cooling under all temperature conditions, summer or winter, because water jackets completely surrounding cylinders and heads assure uniform cooling.



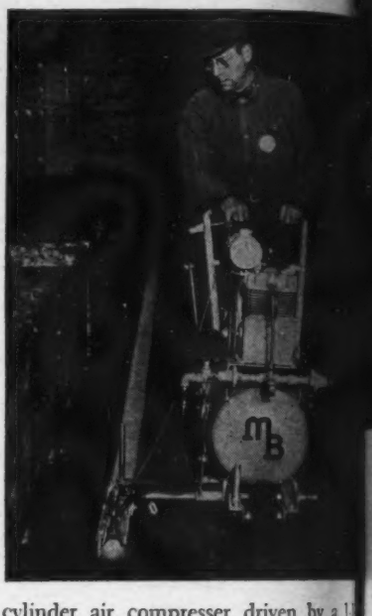

**THE DATA YOU'LL WANT** *before deciding on any compressor can be found in our Catalog 42-S. Your request will bring a copy by return mail. Write today.*

**SCHRAMM INC.**
THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

for roof protection, the pump is mo on a drum or barrel of water, a length of garden hose with an adju nozzle is attached to the pump. The p is self-priming and made in capac from 7 to 25 g.p.m., which will de adequate pressure for a 25- to 30-ft. st of water. Blackmer Pump Co., G Rapids 9, Mich.

## Marking Machine

A compact, lightweight, self-conta unit, marking machine is said to down clean-cut lines on all types of fl The operator controls both the pai and the steering without lifting his h from the handlebar. Pressure for the p spray is developed by means of a t



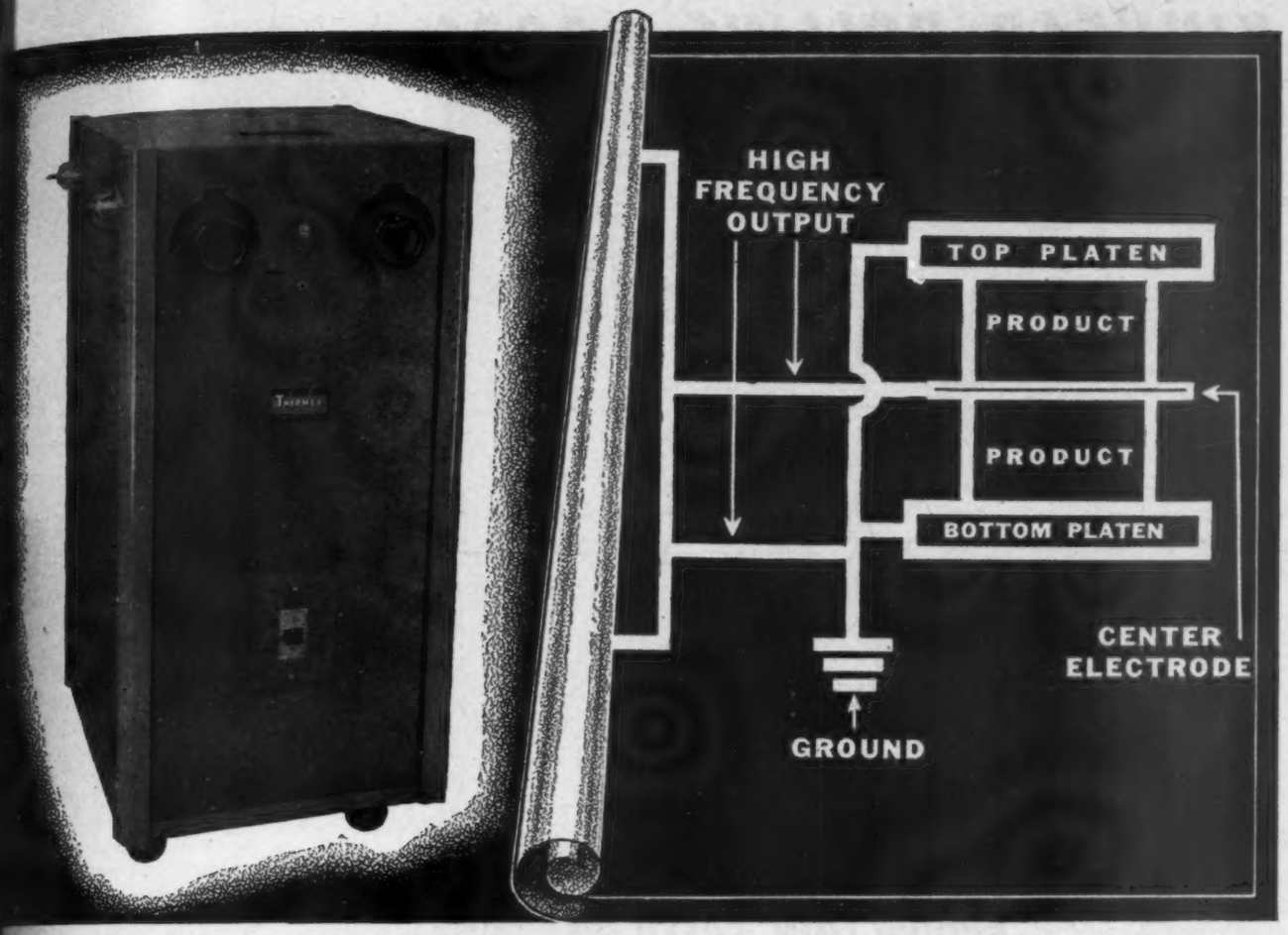
cylinder air compresser driven by a 1 hp. gasoline engine. The paint is appl by an external atomizing spray gun w a wide range of adjustment. Lines c vary from 2 to 6 inches in width. In ad tion to striping aisles, safety zones, st age areas, parking stations, warehouses, t machine can be converted into an a purpose paint sprayer. Meili-Blumb Corp., New Holstein, Wis.

## Carboy Truck

Designed to handle carboys with e and safety, the carboy truck is for u wherever carboys are regularly moved routed. Shafts are adjustable for carb of any size, and the 24-in. diamet wheels are sufficiently large to carry t load over rough floors. Industrial Pro ucts Co., 2820 N. Fourth St., Philad phia 33.

## Electronic Tank Controll

Automatic tank watchman can be p in sole control and remain unattended long plating operations, according to t manufacturer. The tank controller au matically maintains a predetermined s tion level, at the same time control temperature, whether the solution ha tendency to heat or cool. The temper control section is based on a copper ther




# Find out how THERMEX *HIGH FREQUENCY* heating can improve your heating or bonding operations!

ABOVE is illustrated a portable Thermex high frequency unit for bonding or heat processing many non-conducting materials. It is easily moved from place to place, and is simple to operate—as easy as an ordinary radio set. The diagram shows a typical hook-up of a Thermex unit and how two or more pieces of non-conducting materials may be arranged in a press for heating or bonding at one time.

Thermex equipment is in everyday use for bonding plywood and laminated wood, for the production of airplane parts, pre-heating and curing plastic materials, and for many other uses.

The advantages of Thermex high frequency equipment are many. A few are:

Heat processing or bonding at a speed never before attained.
Will heat most non-conducting materials.
Heats thick material as readily as thin material.
Performs difficult jobs well that are impossible with other forms of heating.
Great flexibility. One Thermex machine may be used to supply heat for a variety of consecutive operations.
Rate of heating continuously adjustable from practically zero to maximum capacity of equipment.
Sizes available for *all* requirements.

Send for the complete story how Thermex high frequency heating is *speeding* and *improving* many processes.

Girdler maintains a complete *Application Engineering Service* for your convenience. Compare Thermex performance with your present methods. *Write today for further information.*

**The GIRDLER CORPORATION**

**THERMEX DIVISION • LOUISVILLE, KENTUCKY**

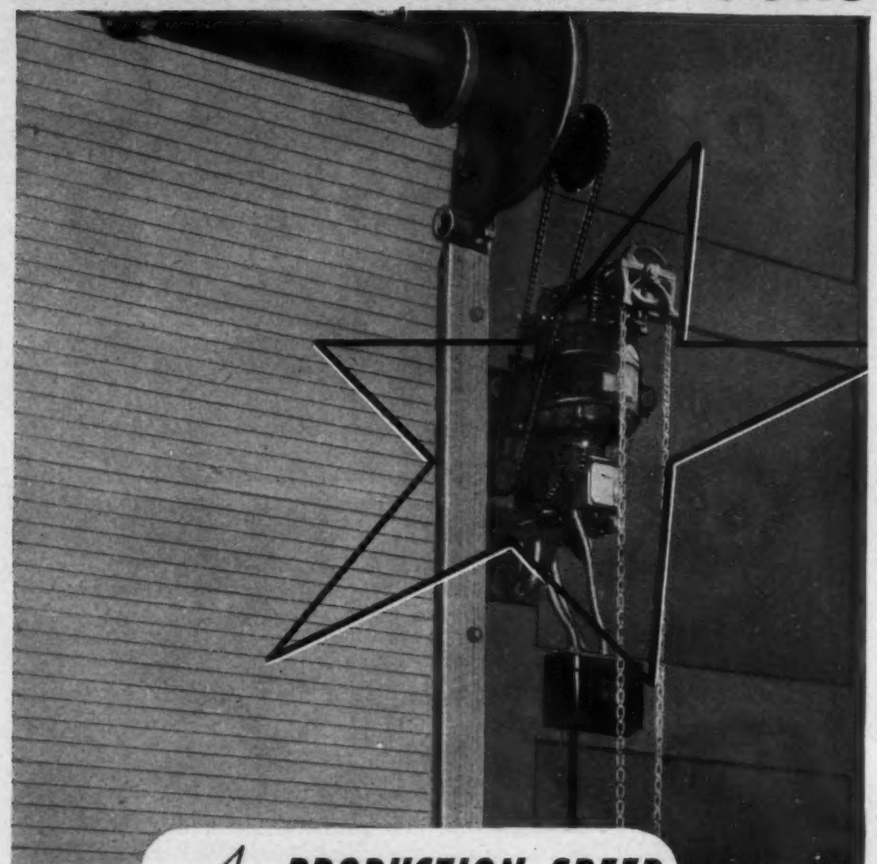
*Buy another War Bond this week!*

THERMEX EQUIPMENT IS DESIGNED FOR THE FREQUENCY BEST SUITED TO YOUR JOB

# THERMEX

## HIGH FREQUENCY HEATING EQUIPMENT

# KINNEAR ROLLING DOORS



## PRODUCTION SPEED DEMANDS MOTORIZED DOOR EFFICIENCY!

**The time-saving, space-saving efficiency of *coiling upward action*—a Kinnear Door advantage that is more vital now than ever before — can be increased still further with *motor operation.* When equipped with rugged, dependable Kinnear Motor Operators, doors can be raised or lowered quickly and safely, from any number of convenient locations, by a momentary touch on the "OPEN" or "CLOSE" button. For safety, a touch of the "STOP" button will bring the doors to an immediate halt at any point in their ascent or descent. And they can be *either* raised or lowered from any intermediate position. Make sure your doors lend maximum aid to the flow of production with the *motorized efficiency* of Kinnear Rolling Doors. Write for information.**

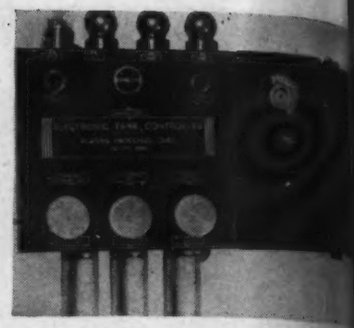
* * *

**For wartime door needs, Kinnear WOOD Rolling Doors, with motor or manual control, are now available. These time-proved doors feature coiling upward action with a rugged interlapping wood-slat curtain that saves vital war metals! Write for details.**

**THE KINNEAR MANUFACTURING COMPANY**
**1540-60 Fields Ave. Columbus 16, Ohio**

SAVING WAYS IN DOORWAYS

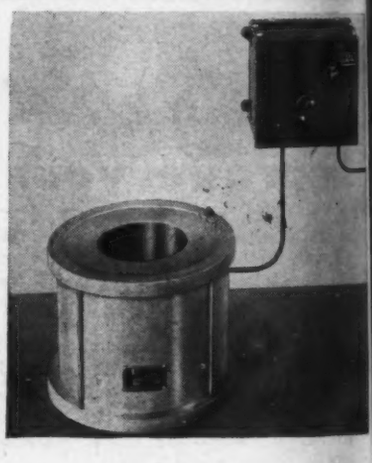
KINNEAR ROLLING DOORS

static bulb for all types of solutions. is designed to provide automatic sta and stopping, and can be set to s operations at a predetermined hour. stallation includes warning signals both the tank and in a watchman's sta affording a constant record of activ The controller is being made in va models to fit a range of requirement Plating Processes Corp., Holyoke, Mass.

## Heat-Treating Furnace

Cub bench-type carburizing furnace is d signed for use with accelerated carbu ing salts, and operates at a maximum te perature of 1600 deg. F. Regulation of t temperature for hardening carbon st parts is provided by the control unit fu nished as standard equipment with th furnace. The control unit combines switch magnetic circuit breaker, and voltage co



trol. The control can be set to "coast" the bath at a low temperature when re quired for intermittent operation. The furnace can be operated intermittently or continuously on a 110/130-volt circuit. Temperature remains constant. Work is insulated from contact with the air. Dimensions of the furnace are 13⅜ inches in diameter, 11 inches high. The seamless, corrosion-resistant alloy pot is 6 inches deep and 6⅜ inches in diameter. Weight is 25 pounds. Industrial Furnace Division, Lee Grinder Co., 4708 Armitage Ave., Chicago.

## Fire Extinguisher Valve

Squeez-Grip valve is applicable to hand type carbon dioxide extinguishers of any size. The valve operates by a lever directly over the carrying handle of the ex-

*ONLY AN ELECTRICAL WHOLESALER COULD THUS SPEED WAR PRODUCTION*

# Mosquito boats roared out 52 days earlier

## *Critical Cable, Located By Wesco, Prevented Work-Stoppage—Assured On-Time Delivery*

The bad news came when the shipyard had only a few days to complete a Navy contract for small high-speed fighting craft. The manufacturer of flexible jumper cable and lugs for storage batteries essential to the flotilla, advised the shipyard —"Cannot deliver; best possible date 45-60 days." Without these small but vital parts, assembling of batteries would stop and delivery of boats on schedule become impossible.

The Navy Department called in the local Wesco house. By contacting suppliers in several cities, Wesco located a quantity of the material 750 miles away. It reached the shipyards the next afternoon. With battery equipment now complete, the shipyard was able to turn the finished vessels over to the Navy within the contract time.

On hundreds of other occasions Wesco has speeded Victory by performing small procurement prodigies leading to big production results. After the war, this service-ability will be available to business and industry everywhere.

**WESCO SPEEDS WAR PRODUCTION**

* An important war plant was destroyed by fire on a Friday. During Saturday and Sunday Wesco delivered a complete list of varied electrical supplies that enabled this plant to resume production on Monday morning.
* An air base required overnight delivery of hundreds of electrical items. Five Wesco houses pooled their stocks —made shipment by the following morning.

**WESCO SERVES BUSINESS**

* By providing trained sales and engineering personnel.
* By buying large quantities at low prices and passing the savings on to small-quantity buyers.
* By warehousing stocks in anticipation of customers' needs.

# Westinghouse Electric Supply Co.

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*Recognized throughout industry for their outstanding qualities and performance*

**In the field of mechanical dust collection, the van Tongeren cyclone, (used exclusively in Buell Dust Recovery Systems) has proved notably efficient and economical for the elimination of hazardous dust nuisances and the recovery of valuable material in**

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**WRITE FOR BULLETIN G-842**

BUELL ENGINEERING COMPANY, Inc.

12 CEDAR STREET, NEW YORK 5, N. Y.

BUY WAR BONDS AND MAKE THE AXIS BITE THE DUST

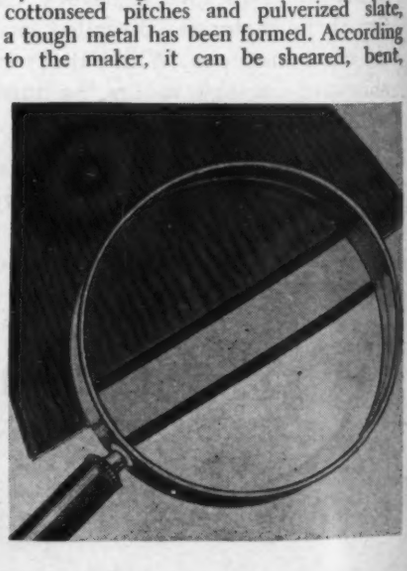
tinguisher. By squeezing with one hand, the valve is opened and gas discharged. On releasing the pressure, the valve closes and the gas discharge is cut off. On closing, the valve is forced tightly against its seat by the gas pressure in its own cylinder. It can be operated without setting down the extinguisher. There are no replacement parts, and the valve does not have to be taken apart for recharging and reassembling after filling. The C-O-Two Fire Equipment Co., Newark, N. J.

## Merger

Babbitt Industrial Specialties Company, New Bedford, Mass., has taken over the development, manufacture, and sale of the industrial sealing compounds formerly made by Namco, Inc., Nutley, N. J. These compounds, called Plastic Sealants, cover a line of plastic joint and gasket compounds, coatings, mastics, and adhesives. The sealants differ from common "pipe dope," according to the manufacturer, in that they have been scientifically engineered to resist extremes in pressure and temperature; expanding, contracting, and vibrating joints; and a wide range of chemicals, solvents, and gases, while retaining workable joints that can be taken down easily and quickly without cutting or sledge-hammering.

## Sheet Metal

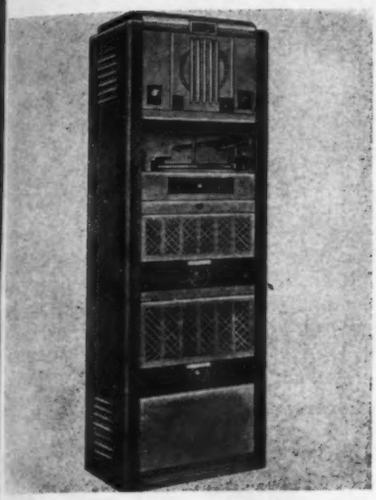
By combining sheet steel with stearine-cottonseed pitches and pulverized slate, a tough metal has been formed. According to the maker, it can be sheared, bent,



Pittsburgh locked, mallated, die-formed, riveted, soldered, and worked with regular shop tools, and forms easily into roofing and siding, spouting, and heating or ventilating ducts. Classified as fire retardant, the metal resists corrosion, weather, and most acid conditions. Does not bleed, and can be painted any color direct to the metal. Is claimed not to run at 230 deg. F., and can be bent double at 32 deg. F. Cheney Metal Products Co., Trenton, N. J.

## Communication System

Standardized and "packaged" in a single unit, the Plant Broadcaster operates 20 to 40 loudspeakers and covers an area of up to 100,000 square feet, according to the maker. For voice-paging and music broadcasting, the unit requires 22 inches



of floor space and comes ready to plug in. Paging calls may be sent over the system while music is being played by means of an automatic control which decreases the music volume. The Broadcaster can also be used to provide plant-protection alarms and air raid warnings. Operadio Mfg. Co., St. Charles, Ill.

## Paint Base for Galvanized Metal

Permanent paint adhesion on galvanized metal with no chipping or peeling is claimed possible by application before painting of Redi-Paint. This compound displaces the slick surface of galvanized metal with a roughened "toothy" surface to form a tight bond with paint. According to the maker, it neutralizes alkalinity and passivates the metal instantly, forming an inactive film which will not become alkaline and is resistant to corrosion. Redi-Paint can be applied by hand with a cloth or sponge or by tank immersion, and leaves a dark, dull color on areas properly treated. Turco Products, Inc., 6135 S. Central Ave., Los Angeles.

## Portable Oil Filter

Self-contained unit, convenient for operating in remote sections, consists of a standard Hilco Hyflow oil filter and a small


# Cut AIR EXPRESS COSTS
## by packing compactly

**AIR EXPRESS** shipments receive such careful handling that the need for heavy cases and bulky packing is often eliminated. Whether your shipment weighs a pound or a ton, follow these two simple rules to cut AIR EXPRESS costs and to save space vitally needed for war goods:

1. Pack compactly, but securely—to obtain best ratio of size to weight.
2. Break large shipments into smaller units whenever possible.

And for fastest delivery—ship early, as soon as package is ready—as early in the day as possible.

### Air Express Speeds War Program

**TODAY,** AIR EXPRESS not only serves the home front but is also working hand in hand with the Army and Navy to supply our fighting fronts the world over.

**TOMORROW,** AIR EXPRESS will girdle the globe in international peacetime commerce . . . to bring *all* foreign markets to the doorstep of American business.

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Gets there FIRST

**Phone RAILWAY EXPRESS AGENCY, AIR EXPRESS DIVISION**
**Representing the AIRLINES of the United States**

**WRITE** for our quick-reference handbook on "How to Ship by AIR EXPRESS During Wartime." Dept. PR-3, Railway Express Agency, 230 Park Ave., New York 17, N. Y.

# B-H INSULATING CEMENT

Test blocks show the difference between corrosive action of B-H INSULATING CEMENT and ordinary insulating cement.

# HAS LICKED CORROSION

*Rust takes it on the chin!*

A perfect bond — that's the beauty of Baldwin-Hill Insulating Cement. How often have you found that moisture in ordinary insulating cement sets up a rusting action releasing the bond, causing peeling and falling?

B-H Insulating Cement is non-corrosive, whether it dries immediately on a hot surface or is allowed to air-dry over a long period of time. On application involving wire this is more important than ever with galvanizing "out" for the duration.

With the famous B-H *black* rock-wool as a base, B-H Insulating Cement is the ideal maintenance insulation effective up to 1800° F. Mixed with water the tightly rolled pellets of wool do not lose their physical form, and so the countless number of entrapped dead air cells within these pellets provide maximum insulating efficiency. B-H No. 1 is easy to apply because it has an exceptionally high adhesive characteristic, and gives high coverage with a very minimum amount of shrinkage.

These advantages of B-H Insulating Cement are real advantages that result in worthwhile savings. Why not let us send you a generous free sample so that you can make your own tests? Write us now on your business letterhead.

BALDWIN-HILL COMPANY

*Insulations*

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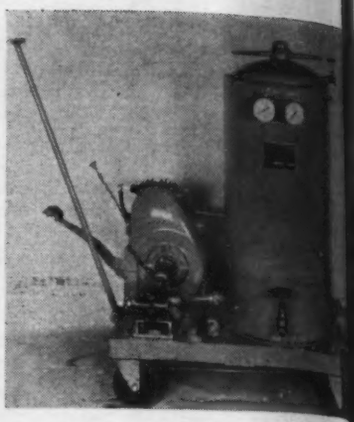


gasoline engine driving a rotary pu for forcing the oil through the fil The exhaust gas is passed through a jac around the filter for heating the filter u Suitable for filtering many types of o including fuel oils, the unit is availab in sizes ranging from 1 gallon per mi ute up to several hundred barrels p hour, depending on the type of fluids be filtered. The Hilliard Corp., 360 W Fourth St., Elmira, N. Y.

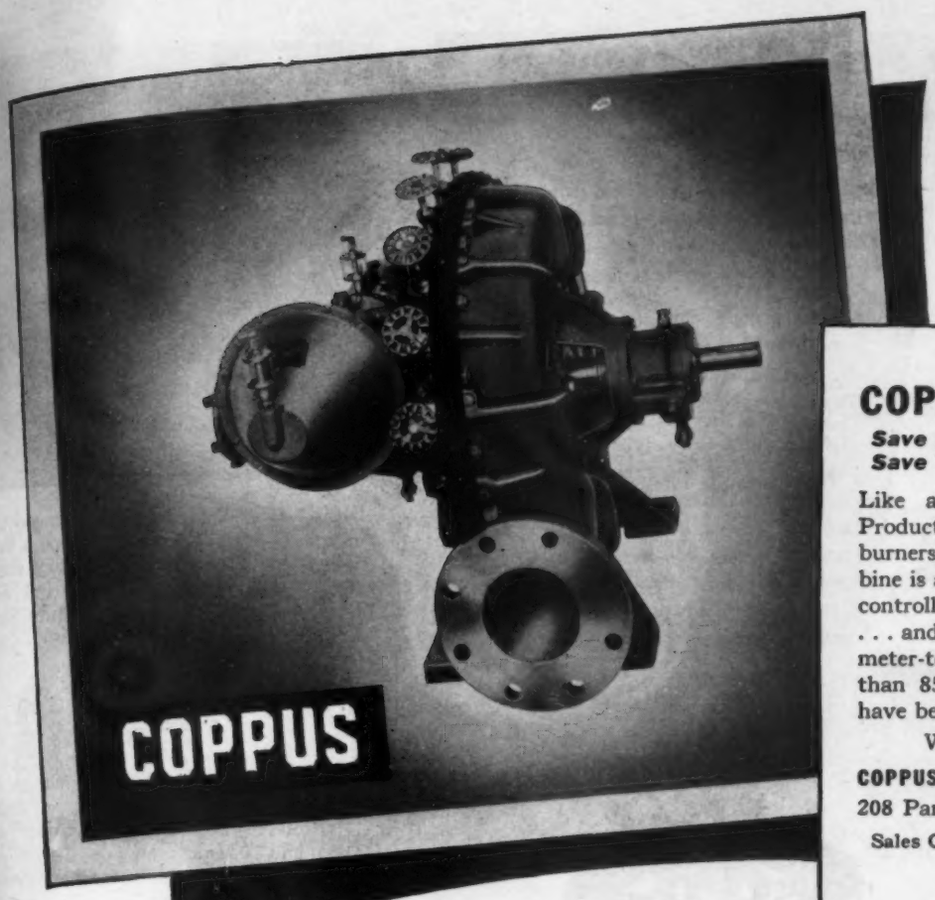
## Turntable

For progressive mounting of two or mo units at one time and for continuous pr duction, turntable is furnished in tw standard sizes, 30x30x3 inches and 42x6 x4 inches, each surface plate having fo

T-slots machined from the solid. A 34-in high model, mounted on a cast-iron stand or a 9-in. high drill base model is avail able. A single-motion locking lever locks the table to the stand. A special rim lock is provided on the low base model. Other sizes are built on special order. The Chal lenge Machinery Co., Grand Haven, Mich.

## Portable Cable Tape Winder

Winder can be used with any standard portable electric drill. A small drive pulley is mounted in the chuck of the drill, and a belt, operating from this pulley, drives the cable taping mechanism which oper ates according to the operator's grip on the drill trigger. Is adjusted to tape cables of different sizes by changing one of the several cylindrical bushings, each of which has the same outside diameter but with an inside diameter to pass a cable of the size to be taped in the operation. The




## COPPUS TURBINES

***Save Metal in Wartime — Will Save You Money in Peacetime***

Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the Coppus steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. More than 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

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Sales Offices in THOMAS' REGISTER
*Sweets' Catalog*

**BLUE RIBBON PRODUCTS**
**DESIGNED FOR YOUR INDUSTRY...ENGINEERED FOR YOU**

If a COPPUS "Horse Power" Steam Turbine can power your pump, blower, fan, stoker, dryer, mixer, etc. . . . then you'd waste money and metal buying an "Elephant Power" Turbine. COPPUS Blue Ribbon Turbines come in 6 frame sizes; matching size to job saves critical metal for war and money for yourself.

And the blue ribbon means workmanship that promises peak performance.

# You Can't Afford Leaky Valves

- Repair parts are scarce
- New Valves require high priorities
- Your present Valves have to serve better-longer
- Regrinding helps make them last longer
- Note the Illustrations showing the six simple operations required

They're expensive and they may result in costly slow-downs and sometimes even shut-downs—which can't be tolerated in these critical times.

With proper care . . . periodic inspection to locate even slight leaks . . . and immediate repair, your valves will serve you better and last longer.

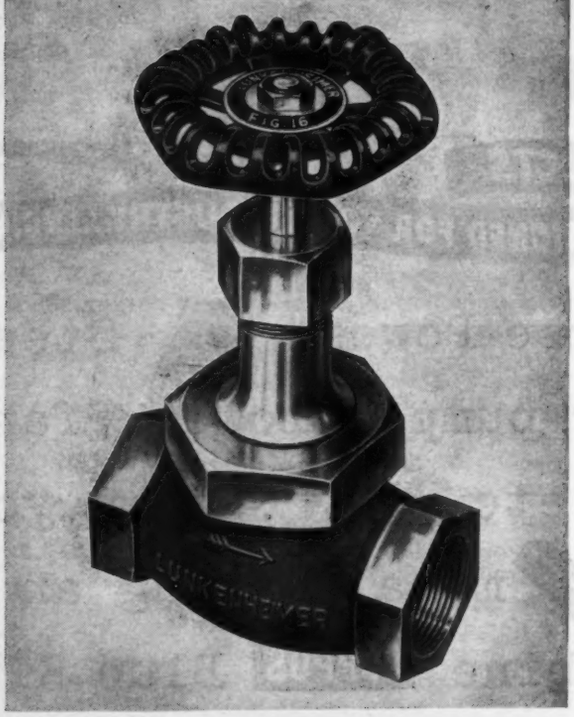
Lunkenheimer Valves are easy to keep in good operating condition. Seats and discs can be readily reground and all parts are quickly accessible without taking the valves out of the line. Properly cared for, they give you a practically permanent installation.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

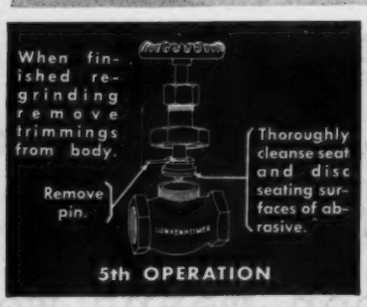
1st OPERATION

2nd OPERATION

3rd OPERATION



Replace trimmings in body and regrind.
Extension on bottom of hub should enter neck of body while regrinding.
Allow union ring to remain loose.
4th OPERATION


When finished regrinding remove trimmings from body.
Remove pin.
Thoroughly cleanse seat and disc seating surfaces of abrasive.
5th OPERATION

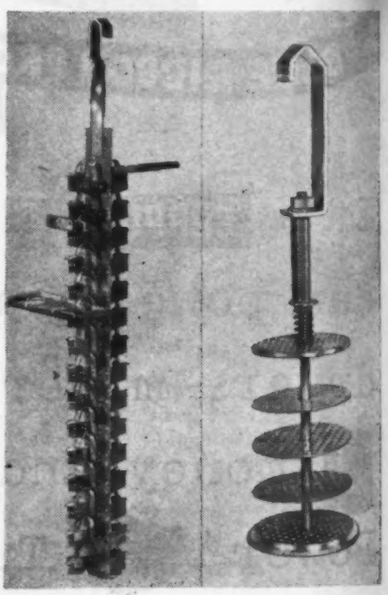
6th OPERATION

LUNKENHEIMER VALVES

tightness of the tape winding around the cable also is adjustable. Will tape a long cable or a plurality of cables into a single unit. Taping operations are in full view of the operator. Leathem D. Smith Shipbuilding Co., Sturgeon Bay., Wis.

## Anodizing Racks and Fixtures

Line of standard racks and fixtures for use in anodizing aluminum parts such as sheets, skins, tubings, castings, bar stock, and a variety of small items has been announced. These racks eliminate



the old slow process of wiring, and may be used over and over with little if any depreciation, according to the manufacturer. They are insulated with a special material, so that no electrical energy is diverted from the work, nor is acid consumed in anodizing the rack. George L. Nankervis Co., 5408 Commonwealth Ave., Detroit.

## Leak Sealer

Flextite is claimed to seal off stubborn, fast-flowing leaks quickly, and is recommended for use in basements, tunnels, pits, passage ways, on seeping tanks, retaining

# War Time is Priceless!

**ORDER ACCESSORIES WHEN YOU ORDER CABLES AND AVOID WIRING DELAYS**

EVEN before the war, the common practice of waiting to order cable accessories until the cable for the job had been shipped frequently caused days of delay.

Today, however, it may even take a month or more before an accessories order can be approved and materials started on their way.

This holds up the wiring job unnecessarily. In the meantime, workers may be idle—and not just electricians alone, for other workers all along the line may be affected. Today, if never before, follow this wartime-saving practice:

1 Order accessories and cable at the same time —for delivery together.

2 When ordering unit package jointing material, include your order for terminals and potheads. If buried cables, remember joint boxes.

Every Anaconda unit package contains instructions and all materials required for the particular job. When ordering, please specify number of unit packages needed, operating voltage, size, number and shape of conductors, thickness and kind of insulation, thickness of lead sheath of cable.

ANACONDA

## ANACONDA WIRE & CABLE COMPANY

GENERAL OFFICES: 25 Broadway, New York City

*Subsidiary of Anaconda Copper Mining Company*

CHICAGO OFFICE: 20 North Wacker Drive • Sales Offices in Principal Cities

# IT WILL DO A BETTER JOB ON THE SCRAP PILE THAN ON YOUR HEATING SYSTEM!

This country needs scrap metal . . . for war purposes, *but not in heating systems!* Here, nothing but the most efficient heating units can do the job of keeping industry in production and fuel consumption at a minimum. Junk equipment must be consigned to the junk pile!

Examine your heating plant—*now*—with the idea of settling two important questions. First, is it cooperating with the very real need for fuel conservation? Second, is it helping your profit picture by keeping operating expense at rock bottom? If not, *remember that steam-wasting equipment will do a better job on the scrap heap than on your heating system!*

Hoffman Steam Specialties will make your modernizing program a genuine success. Not only are they recognized by critical steam plant operators as highly efficient units, but they have features which substantially prolong service life.

For example, the Seats of Hoffman Traps are renewable. Should long service cause wear, simply remove the Seat and screw in a new one. The Thermostat, too, can be replaced without adjustment. In the Hoffman 50 Series Trap, a heavy duty unit, the Float, Valve Pins and Seats are *reversible*—giving double life at no extra expense.

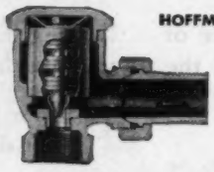
And now, while you are thinking about it, send for the new Hoffman Steam Specialties Engineering Bulletin. Remember that Hoffman field engineers are always available for consultation on your heating problems.

**HOFFMAN SPECIALTY COMPANY**
**1001 York St., Dept. FM-8, Indianapolis 7, Ind.**

**CHECK THESE POINTS FOR "SCRAP PILE" TRAP SPECIMENS**

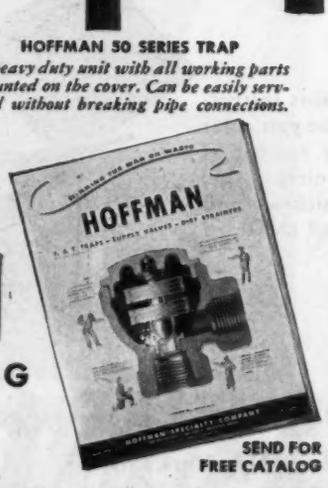
√ Steam Radiators √ Unit Heaters
√ Pipe Coils √ Downfeed Risers
√ Condensing Radiators √ Blast Coils √ Ends of Steam Mains, etc.

**. . . AND REPLACE WITH DEPENDABLE HOFFMAN TRAPS**



**HOFFMAN No. 9H TRAP**
*A bronze-bodied unit for high pressure work. Renewable Seat and Thermostat.*

**HOFFMAN 50 SERIES TRAP**
*A heavy duty unit with all working parts mounted on the cover. Can be easily serviced without breaking pipe connections.*




**SEND FOR FREE CATALOG**

# HOFFMAN

**CONTROLLED HEATING**

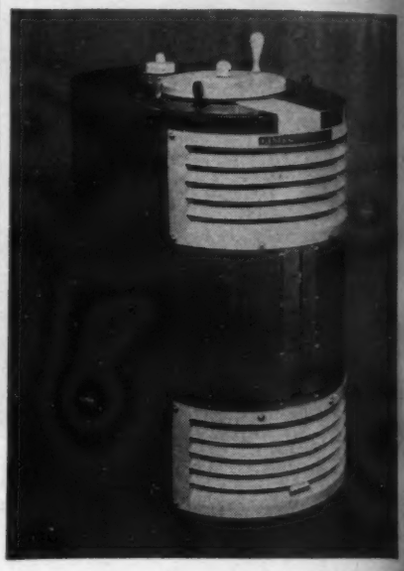
**STEAM HOT WATER**

**MAKERS OF VALVES, TRAPS, VACUUM AND CONDENSATION PUMPS, FORCED HOT WATER HEATING SYSTEMS**


walls, and similar areas subject to leaks and seepage. According to the manufacturer, Flextite can be used as a trowel coating to convert a damp, wet basement to dry working or storage space. Flexrock Co., 2317-a Manning St., Philadelphia.

## Outdoor Welder

Outdoor a.c. welder which has a welding current range from 100 to 625 amperes at 40 volts has been announced. It is equipped with an "idlematic" control which automatically reduces the output voltage to less than 35 volts whenever the arc is not in operation, but provides full power for welding the instant the arc is struck. This control also includes a switch



operated by a handle extending through the top of the case for starting or stopping the welder manually. The welder is protected by drip-proof construction of all openings in the top of the case and by a sealed window over the current indicator. Wide, water-shedding louvers keep air velocity low. All internal parts have a special finish for protection against corrosion from moist air. The welder has built-in power-factor improvement which provides low current input by maintaining the power factor at 95 percent or better at all loads between 40 and 70 percent of rating. Has finger-tip adjustment, stepless current control, fan-forced ventilation, and capacity for operation with long leads. General Electric Co., Schenectady.

## Fly Cutter

Designed for cutting holes or disks in metals of thicknesses up to 1 inch, this fly cutter may be used on boiler plate, stainless steel, cast iron, plastics, rubber, and other materials. Generous clearance between work and the body of the cutter relieves strain on the tool. It is obtainable with straight or tapered shank, and covers expansions of 4 to 10 inches in diameter, including fractional intermediate sizes. Tools are provided for cutting holes from $\frac{3}{8}$ to 10 inches in diameter and straight side disks from 4 to 10 inches in diameter. Models for cutting diameters from $\frac{3}{8}$ to 5

# THE SUB-BUSTER THAT WASN'T THERE

"We didn't have a chance. That murderous Nazi's fire whiplashed our open boat. Helpless, we ducked, and those who could, rowed on. Out in a ghostly glare, our ship went down.

"'By God, we'll make them pay for this,' said First Mate Stone, clenching his fist. Just then, a bullet got him in the throat.

"Your mind plays funny tricks at times like that. As those devils strafed us bow to stern, I seemed to see a DE Ship lunging in to pay them back a bit. Whenever I looked close, it wasn't there, and I kept wondering why."

* * *

Thousands of tiny parts make ships, planes, tanks, trucks, guns. In many cases, men's lives depend on *when* and *how* those parts are made.

Here, at R B & W, making millions of bolts and nuts every day, we have pledged ourselves to the realization that every part, even the smallest, counts. To special bolt-and-nut-making processes insuring flawless strength and accurate fit . . . we are adding, each one of us, the personal care and extra effort needed for world-wide victory.

Perhaps the workers in your plant would benefit from a clearer idea of what our soldiers and sailors are enduring. How important *each* one's part is . . . is the basic theme of a series of posters based on ads like this one—posters freely available to every "bits and parts" manufacturer. Write us. Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

**RB&W** *Making strong the things that make America strong*

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

# ...and OAKITE CLEANING CAN HELP YOU attain these *FOUR* important war objectives:

**1 *Speeding-Up Maintenance***
**2 *Shortening Equipment Down-Time***
**3 *Conserving Man-Hours***
**4 *Making Equipment and Machines Last Longer***

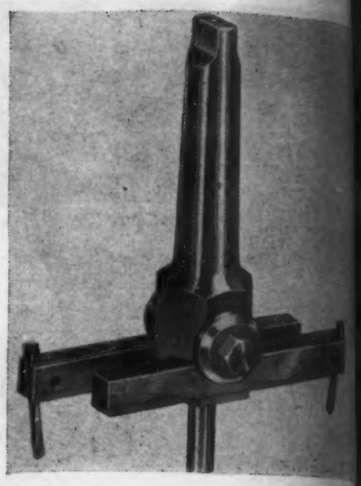
Specialized Oakite materials, techniques and procedures... developed in 35 years of active service to industry... are "at work" today in thousands of plants and mills the nation over. This fund of industrial cleaning experience is at your command to help put ALL your maintenance on a FASTER, more EFFICIENT BASIS.

## EASIER WAY TO DO 54 JOBS!

On such jobs as cleaning heat exchangers; air conditioning equipment; descaling water-cooled equipment; cleaning machinery before repair, overhaul or repainting; stripping paint, lacquer from motor housings, armature coils; cleaning air hose, conveyer belts... you will find speedy Oakite techniques HELP YOU complete this work easier, faster, with no extra demands on available manpower. Ask for NEW OAKITE MAINTENANCE DIGEST describing 54 commonly recurring maintenance jobs. It's FREE to all factory and mill executives. Write for YOUR copy today!

**OAKITE PRODUCTS, INC., 14A THAMES STREET, NEW YORK, N. Y.**
*Technical Service Representatives in All Principal Cities of the United States and Canada*

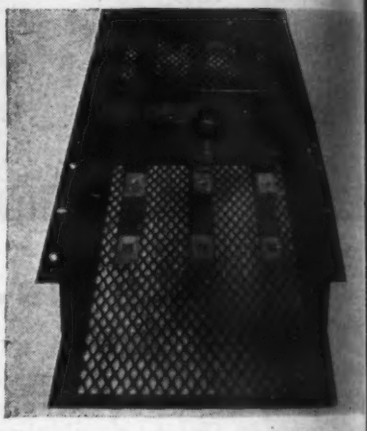
**OAKITE** MATERIALS...METHODS...SERVICE — Buy Bonds for Victory — **CLEANING** FOR EVERY CLEANING REQUIREMENT

inches, and for cutting holes in pipe and curved surfaces, have three cutting blades. Those for cutting diameters from 4 to 1[illegible] inches have two blades. Robert H. Clark Co., 3424 Sunset Blvd., Los Angeles 2[illegible]

## Ventilated Feeder Bus Duct

Redesigned feeder bus duct of the ventilated type has a screened casing of expanded metal, which is claimed to assure low operating temperatures and increased current carrying capacities. The painted phase bus bar arrangement within the ca[illegible]

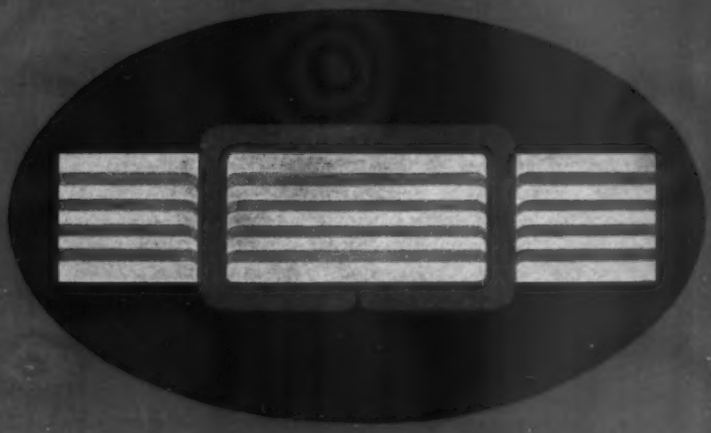


ing permits uniform current density. The duct can be used for feeders alone or in conjunction with a branch circuit plug-in type Bustribution duct. Available in WPB ratings of 800A, 1000A, 1350A, 1600A, and 2000A single-phase, 3-phase, and 4-wire 3-phase, 600 volts or less. BullDog Electric Products Co., 7610 Jos. Campau Ave., Detroit.

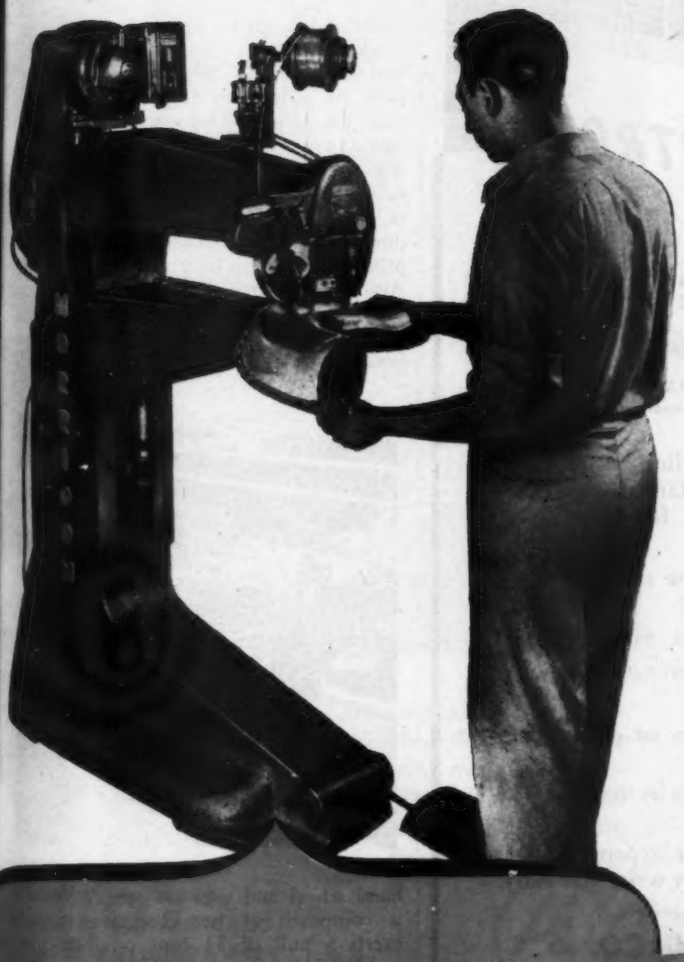
## Bench Grinder

Model 135 bench grinder and polishing machine is adaptable to any type grinding and finishing from flat pieces to irregular shaped parts. Mounted on a sturdy, one-piece base, it features precision ball-bearing construction throughout. Controls are located at the front of the unit, handy to the operator, for belt alignment. An adjustable spring tension device on the idler pulley maintains belt tension. The model is equipped with a cushioned, segment face

# Assemble aircraft parts with this STITCH and save manpower time and materials



THIS section (three times actual size) illustrates the tight corners and full bearing of wire against alternate sheets of .020 24ST and 24SO Aluminum, made possible by using Morrison Aircraft Metal Stitchers and U.S.S. American Aircraft Stitching Wire.



**S**avings in manpower, time and material by use of Morrison Aircraft Metal Stitchers and U.S.S. American Aircraft Stitching Wire are truly amazing. Unusually high-tensile-strength wire gives the required penetration in aluminum sheets and other metal parts. An especially developed and applied zinc coating protects against corrosion. It is government approved for fastening many aircraft parts.

With the development of Morrison Aircraft Metal Stitchers, remarkably fast and economical application of this new wire has been achieved. Actual man hours were cut over 86% on the first five applications converted to stitching at Curtiss-Wright.

You can duplicate savings like these in your plant . . . and you can do it whether you work with Aluminum, Stainless Steel, Plastics, Cork, Rubber, Asbestos, Wood or Canvas, and are now riveting or welding any or all of these products. It will pay you to write or wire today for complete details and performance records available in Bulletin No. 8-F.

**MORRISON**

PRODUCTS OF THE SEYBOLD DIVISION
HARRIS-SEYBOLD-POTTER COMPANY
DAYTON F7, OHIO

**STITCHERS**

# SLY DUST CONTROL
## HELPS MAINTAIN QUALITY AND QUANTITY

Sly Dust Filter exhausting blast room in large foundry.

THROUGHOUT industry Sly Dust Control is aiding both quality and quantity of production. It means cleaner plants, with better working conditions* for employees—a safeguard for health—an incentive for good and *continuous* work.

This system offers certain *exclusive* features because of the advantages of Sly Dust Filters (the heart of the system):

1. Greater filtering capacity because of more filtering cloth
2. Taut bags (patented) save power and improve dust removal
3. Bags more easily replaced
4. Automatic control (any degree) minimizes or entirely removes the human factor
5. Simpler shaker mechanism results in savings in maintenance and operation.

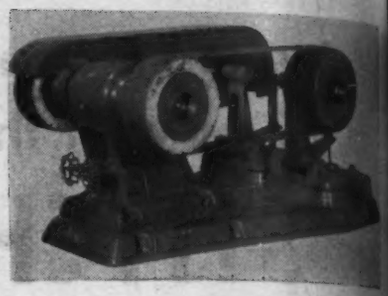
With all of its advantages, Sly Dust Control is *not* expensive. Ask for Bulletin 98 and state your problem so that we may write you fully.

**Good working conditions cut down absenteeism.*

**W. W. SLY MANUFACTURING CO.**

4755 Train Ave. Cleveland, Ohio

SLY
INDUSTRIAL DUST CONTROL

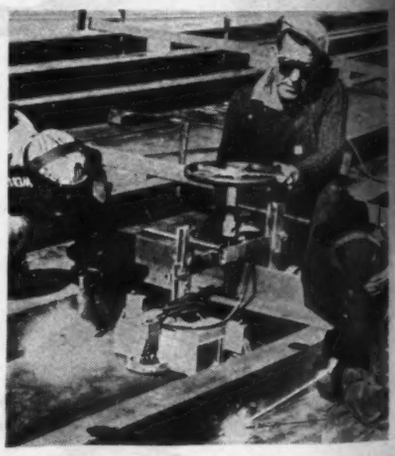
contact wheel; endless abrasive belts, and a 3/M rubber contact roll. It may be used with any ¾- to 2-hp. motor. Jones Engineering Co., Ellwood City, Pa.

## Floor Product

AWOG is recommended for new floors; for overlays on concrete, brick, stone, or wood; for repairing and resurfacing areas of any size. It is claimed to resist acid, water, oil, and grease, and to withstand heavy traffic. Smooth, and dustless, AWOG is easy to keep clean. Flexrock Co., 2317 Manning St., Philadelphia.

## Magnetic Clamp

Sweetland magnetic clamp for positioning welded members is an electro-magnetic tool, designed for shipyard use but applicable by adaptation to a wide variety of uses. Of lightweight construction, the device is equipped with retractable ball-bearing wheels working on a ball-bearing swivel. Stiffeners are positioned and held in place while the tack welds are made directly without the use of saddles, clips, or other means requiring temporary welds. Available in three models, B and C comprise two-magnet units coupled together with a yoke, provided with vertical and horizontal adjustments. The yoke carries a



hand wheel and pressure screw. Model B is composed of two 2-section magnets; exerts a pull of 3½ tons on ½-in. plate, weighs 210 pounds and is adapted for stiffeners 8 inches high or less. Model C utilizes two 3-section magnets; exerts a pull of 4½ to 5 tons on ½-in. plate, weighs 300 pounds, and is for girders up to 18 inches. Model HVC is composed of a 3-section horizontal magnet and a 1-section vertical magnet to hold the stiffener in place in a 90-deg. position. It is furnished

# Why there is only One Man in this picture

## Or How to Make Your Employment Department Happy

On page 3 in the current Lo-Hed Catalog and, in many earlier issues, you will find this brief statement: "Can be operated with one hand by one man". *That is a fact.* A Lo-Hed Hoist can be operated by one man with one hand, leaving the other hand free to guide the load. And that is the kind of hoist you need any place in your plant—wherever labor is scarce, wherever the time of men and women must be saved. Don't waste productive time and payroll on tiring, back-breaking, brute jobs. Let a Lo-Hed do the heavy lifting.

Write or telegraph for full information on a Lo-Hed Hoist.

### LO-HED IS THE "BALANCED" HOIST FOR HEAVY DUTY SERVICE

The *balanced* arrangement of motor and drum in a Lo-Hed Hoist allows the hook to be pulled up until it almost touches the beam—a desirable plus feature for which you pay no premium. This same arrangement makes possible the use of an all spur gear drive from motor to drum.

Other important features of the Lo-Hed Hoist are the heavy duty hoist motor; strong, short shafts; high duty bearings; 100% positive automatic stop; and removable protective covers for all vital parts.

***The Lo-Hed Hoist can be adapted for operation on any monorail system. There's a Balanced Lo-Hed Electric Hoist for Every Purpose.***

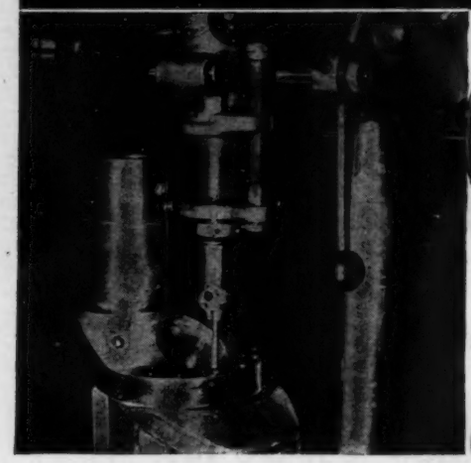
*Other A-E-CO Products:*
**TAYLOR STOKERS**
**MARINE-DECK AUXILIARIES**
**HELE-SHAW FLUID POWER**

AE CO 75th ANNIVERSARY

**AMERICAN ENGINEERING COMPANY**

**2426 ARAMINGO AVENUE**
**PHILADELPHIA, PENNA.**

# "HARDSTEEL" DRILLS



## Save 6 Hours Time

## . . . Removing Broken Tap from Wright Crankshaft!

**In the plant of one manufacturer of Wright crankshafts, "HARDSTEEL" drills are saving time and giving 100% parts recovery when taps break in blind holes.**

**FORMER PRACTICE**

**Grinding out tap with pencil grinder—time 8 to 8½ hours—frequent loss of the part when grinder defaced threads.**

**PRESENT PRACTICE**

**Drill about ⅛ inch into tap with a "HARDSTEEL" drill—enlarge hole by grinding—drill again—grind and continue until tap is cut out. Time 2 to 2½ hours—no loss of parts.**

**This is just one of hundreds of applications where the ability of "HARDSTEEL" drills to drill, ream, countersink and counterbore steels hardened by any process pays big dividends.**

**Ask for a copy of the "HARDSTEEL" Operators Manual—24 pages of practical information that will prove the value of "HARDSTEEL" tools in any service shop. Free on request.**

**BLACK DRILL CO. • 5005 Euclid Ave., Cleveland, Ohio**

***"You Harden It... We'll Drill It"***

**"HARDSTEEL"**

DRILLS · REAMERS · TOOL BITS · SPECIAL TOOLS


with a Johnson bar. A G-R 12-amp. rec fier is available to rectify alternating c rent and supply power for use with clamp, or it may be operated from power supply of a motor-generator weld set, or from any 80-volt direct curre Glenn-Roberts Co., 1009 Fruitvale Av Oakland, Calif.

### Spray Gun

Thor 17 spray gun is being produced a substitute for Thor 7 and Thor 2 s gun models. Although it does not the elaborate finish of its predeces

Thor 17 is recommended as an efficien general-purpose spray painting and finish ing gun that is available for quick deliv ery. Binks Mfg. Co., 3114-40 Carro Ave., Chicago 12.

### Flow Indicating Meter

Flow indicating meter, calibrated to rea in liters of oxygen per minute, is con structed entirely from metal. Operate by the principle of a floating piston whos positioning is actuated by the flow o gas through an orifice of variable area. Th piston is lifted by the incoming gas unt its weight balances the pressure los through the orifice area. At the point o balance the flow rate may be read di rectly from the pointer which is attache

# MAKE THIS TEST — Prove BRIXMENT is BEST!

1

2

**Above: A cylinder of Brixment mortar (left) and a cylinder of mortar made with 50-50 cement and lime mortar (right). Both specimens were made at the same time, and subjected to exactly the same treatment. After curing for 30 days, ¼" of water was put into the tray and the cylinders were alternately frozen and thawed 15 times. Note in photo 2 that Brixment mortar remains intact, whereas the other mortar has crumbled badly. This simple test can be made in any ice-manufacturing plant.**

# BRIXMENT *Makes More* DURABLE *Mortar!*

FOR permanent strength and beauty, mortar must be *durable*—must be able to withstand the alternate freezing and thawing to which it is subjected many times each winter.

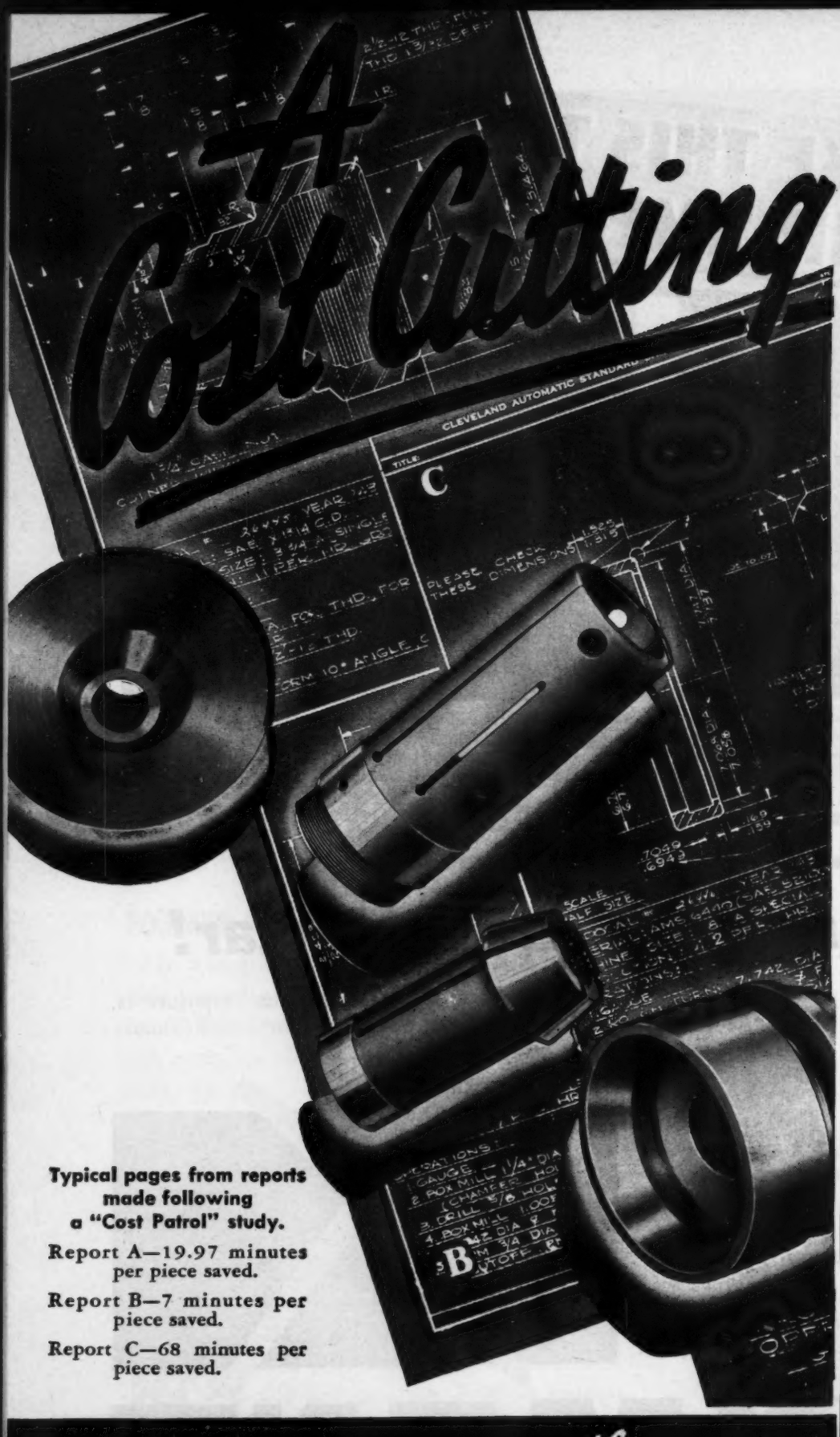
Brixment mortar *is more durable.* This greater durability is due partly to the strength and soundness of Brixment mortar, and partly to the fact that Brixment is waterproofed during manufacture. This waterproofing helps prevent the mortar from becoming saturated—therefore protects it from the destructive action of freezing and thawing.

Walls built with Brixment mortar therefore *retain* their original strength and appearance. Even in parapet walls and chimneys, where exposure is particularly severe, Brixment mortar will almost never require re-pointing.

# BRIXMENT

## For Mortar and Stucco

*Louisville Cement Company, Incorporated, Louisville, Kentucky. Cement Manufacturers for Over a Century.*




**Typical pages from reports made following a "Cost Patrol" study.**

**Report A—19.97 minutes per piece saved.**

**Report B—7 minutes per piece saved.**

**Report C—68 minutes per piece saved.**

**CLEVELAND**

*Single Spindle* **AUTOMATICS**

MODEL A—Built in 9/16-inch to 9 1/2-inch capacities

MODEL B—Built in 9/16-inch to 2 1/2-inch capacities


to the piston. Simple in design, the me is easy to inspect, clean, and maint in accurate condition. Compact, lig weight, and durable, four sizes are av able to record a maximum flow rate of 5, 10, and 150 liters per minute. Pittsbu Equitable Meter Co., 400 N. Lexing Ave., Pittsburgh.

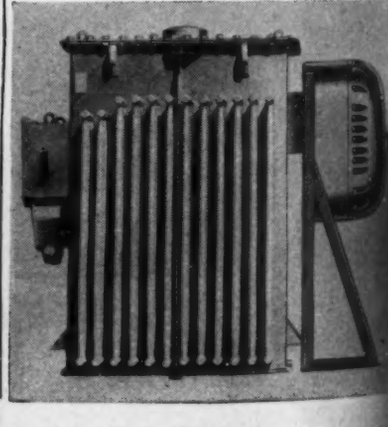
## Medical Cabinet

Prompt-Aid medical cabinet, designed t on-the-spot use in emergencies, rolls o ball-bearing casters. It is equipped wi one container for 12-in. adhesive plast or various sizes of surgical tape; four 4x in. glass dressing jars with glass cove

five 4-oz. solution bottles with glass sto pers; four 2-oz. solution bottles with gla stoppers. The cabinet is built with on instrument drawer, three supply drawer and a two-door storage compartment. Th two-section cover folds to each side of th cabinet, making the working area 42x1 inches. Has baked enamel finish. The J. E Erback Co., 1170 Broadway, New York

## Load-Center Unit Sub-Stations

Line of load-center unit substations fo semi-hazardous locations has been an nounced. Available in standard ratings from 100 to 1000 kva. at 480 volts an 100 to 500 kva. at 208/120Y or 240 volts these units can be used indoors or outdoor for power and lighting service of 600 volts and below. Primary voltages from 2.4 to 15 kv. can be handled. Metal inclosed the line incorporates a liquid-filled primary



# Tool — FOR MANAGEMENT

CLEVELAND'S Single Spindle Automatic has established a reputation, not only as an outstanding machine tool in individual performance, but as a particularly fine "tool for management". By management we mean clear across the board from production men to presidents—anyone whose headache it is to produce, to profit, and to maintain employment.

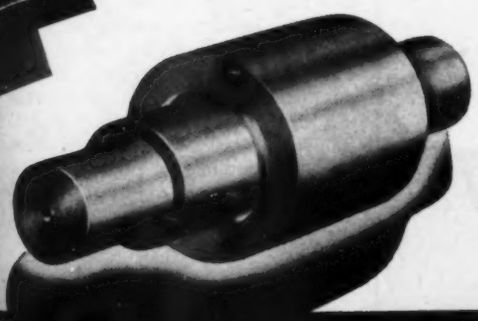
This is true because the very essence of Cleveland design is unending search for the last word in elimination of waste motion and material in production. With every Cleveland has gone (in addition to modern development of the tool itself) full benefit of the advice and counsel of engineers whose years of specialization have made them authorities on methods.

This advice and counsel now are made available to *all* management, whether owners of Clevelands or not, in a new service. We call it a "Production Cost Patrol" because its purpose is to help your production men "police" methods for all possible improvement. The steps are simple . . .

1. Upon request you will be given a statement in detail of the engineer's method of surveying your plant, and his credentials will be submitted.
2. The engineer will spend as much time as necessary in your plant, making detailed studies of operation without interrupting production or making demands upon the time of your organization.
3. A detailed written report will be made for you, with proposals for changes in method wherever opportunities for savings are found.

Proposals for improved method are by no means limited to cases where the savings can be made on Clevelands. In many studies made by Cleveland engineers new methods involving substantial savings have been found for the equipment already in use. In any event there is no charge.

*If you have a rush problem, a collect wire will bring prompt consultation.*



## THE CLEVELAND AUTOMATIC MACHINE COMPANY

CLEVELAND, OHIO

ARMY NAVY

SALES OFFICES

CHICAGO: 1408 Civic Opera Building
DETROIT: 540 New Center Building
NEWARK: 902 American Insurance Building
CINCINNATI: 1315 American Building

*. . . it's the answer to another special war tool problem*

**CAN WE SOLVE ONE *for You?***

**This special tool cut assembly time in half on a certain operation vital to war production. Analyze your problems. Could a specially designed tool save time and money for you, too? If so, consult us.**

**Plomb dealers handle stock tools for professional mechanics**

**Throughout the nation, dependable dealers carry complete assortments of supreme quality Plomb tools for war production and maintenance. For the fine hand tools you need, call the Plomb dealer nearest you.**

**Plomb gives you a 2-fold service**

**Plomb offers a double service to help speed your war job. It is made possible by the cooperation of 36 separate plants in making the fine hand tools we need for victory. Take advantage of it in these two ways: 1. Consult our engineers for special tools; 2. See your Plomb dealer for regular tools.**

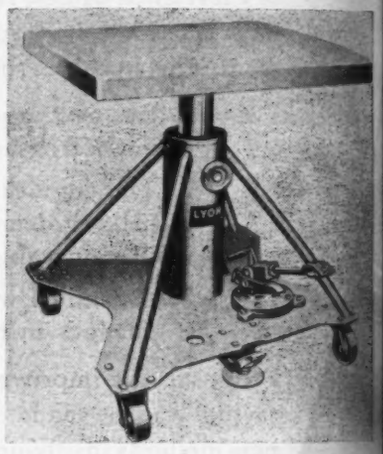
**PLOMB**

**PLOMB TOOLS CONTRACTING CO. *A Division of the***
**PLOMB TOOL COMPANY**
LOS ANGELES ▽ CALIFORNIA


disconnecting switch, standard Pyranol or oil-filled transformer section, and a low-voltage section with a 600-volt, removable air circuit breaker. All arcing parts are either liquid immersed or in inclosures of Class I, Group D construction. The transformer has four 2½ percent taps in the high-voltage winding. Incoming line switch is mounted integral with the transformer section and is equipped for breaking transformer magnetizing current. A key-type interlock works in conjunction with a similar lock on the low-voltage breaker to prevent the switch from being operated when load is on the transformer. The low-voltage section is furnished with either a manually or an electrically operated main secondary air circuit breaker with time-over-current protection and instantaneous short-circuit trip. Breaker is metal inclosed. General Electric Co., Schenectady.

## Hydraulic Elevating Table

Improved elevating table for handling dies, transferring heavy parts from one level to another, supporting overhanging work, and other uses has been announced. The table operates with all loads up to its maximum capacity of 2000 pounds. The top is 30 inches square, having a lowered




height of 29 inches and an elevated height of 43 inches. The standard stock table can be furnished with seven optional features: Floor lock to keep the table from moving on its casters; spring balanced towing handle; locking device which allows table top to be turned and locked each 15 degrees; collapsible retaining bars for table sides; four swivel casters in place of the standard two swivel and two stationary casters; of stationary type; two-speed hydraulic foot pump substituted for the single speed pump. Other sizes are also furnished. Lyon-Raymond Corp., 1226 Madison St., Greene, N. Y.

## Automatic Lubricator

Air-Lube lubricator for feeding a regulated oil mist into air tools is recommended for use in the air hose from 1 to 6 feet from the tool, or may be used in air pipes for larger air-driven stationary or semi-portable tools. It is also adaptable for air passages in a machine. Positive feeding action provides a regulated amount of oil while the tool is in operation. The oil reservoir holds

# Who's going to be the successful manufacturer TOMORROW?

YEARS ago, on the heels of those days when cast iron typified heavy machinery design in general, and crane design in particular, Northwest pioneered and proved in the field that better machinery meant lower cost operation and increased output.

Now when the pressure of the emergency is testing equipment far beyond anything that peace times ever imposed, it is the machinery that is built to do the job, not to meet a price, that is coming through.

No one knows how long the war will last, but some time there is a new day coming and the man with the best equipment is the one who is going to meet the competitive battle successfully.

Northwest advantages have been proved by the fact that one out of every three Northwests sold for years has been a repeat order in the hands of leading manufacturers. You may want information for future plans. We'll be glad to give it to you. Buy War Bonds and watch Northwest.

...THE COMPANY WITH THE BEST EQUIPMENT

ORTHWEST ENGINEERING CO
05 Steger Bldg. · 28 E. Jackson Blvd.
Chicago · Illinois

# NORTHWEST

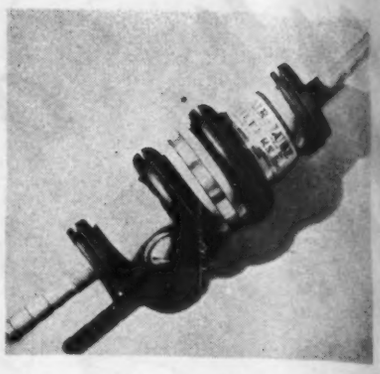
*Write*
FOR NEW 192 PAGE
DARNELL MANUAL

# DARNELL
## CASTERS & WHEELS

*Built-in quality assures a long life of efficient service—it pays to "Demand Darnell Dependability".*

**DARNELL CORP. LTD.,**
**LONG BEACH, CALIFORNIA,**
**60 WALKER ST., NEW YORK, N.Y.**
**36 N. CLINTON, CHICAGO, ILL.**

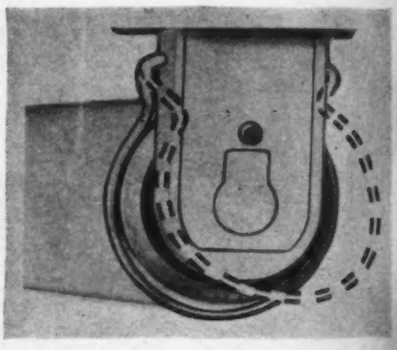
**A SAVING AT EVERY TURN**



enough oil for more than a week under normal usage. Clear lucite window shows when it needs refilling. Positive regulated wicking action with an automatic shutoff prevents any flooding of air tools with oil. Unless otherwise specified two standard settings are provided. Filters, Inc., 1515 Gardena Ave.. Glendale, Calif.

### Fluorescent Fixtures

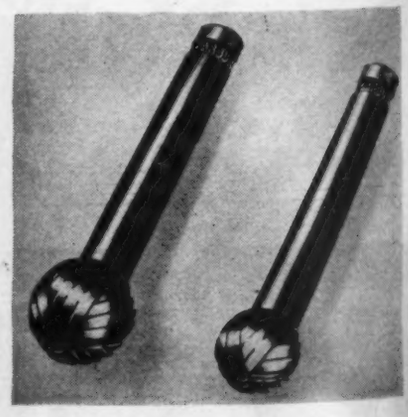
Safety lamp lock is an integral part of each socket of Aero-Designed fluorescent fixtures. This device minimizes the risk



of lamps falling from sockets, and is claimed foolproof under all conditions. Simple in construction, it does not interfere with fixture relamping and cleaning. The Miller Co., Meriden, Conn.

### Burring Tools

Cemented-carbide burring tools to be known as Carburs have been announced. Sharp-edged and wear-resistant, these tools can be run at high speeds. They are supplied in ball end types in $\frac{3}{8}$- and $\frac{1}{2}$-in. diameters on the carbide ball end. The



# HIGH PRESSURE GASES
## have many war jobs to do . . .

## *and Kidde makes the right container for each of them*

★ Today there is far greater use for high pressure gases than ever before. Kidde has kept pace with this development by providing containers in an ever-widening variety of shapes and sizes. Special purpose valves and release mechanisms have been devised by Kidde engineers for proper application of the gases.

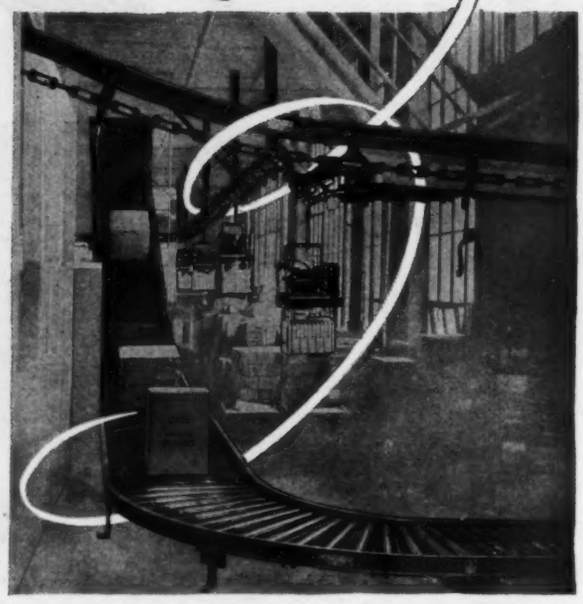
Kidde cylinders are used for storing liquefied carbon dioxide and hydraulic fluids under pressure, for oxygen, nitrogen, helium and other gases.

If *you* need help in solving a high pressure container problem, write us telling us about your requirements. Let us work with you to develop the right container for your particular needs. Walter Kidde & Company, Inc., 827 Main St., Belleville, N. J.

**Kidde** PROTECTS LIVES

HIGH PRESSURE GASES • FIRE PROTECTION

# BUSCHMAN *Conveyors*



**ALL TYPES OF CONVEYORS FOR EVERY INDUSTRY**

●

**A SIZE AND TYPE FOR EVERY PURPOSE**

●

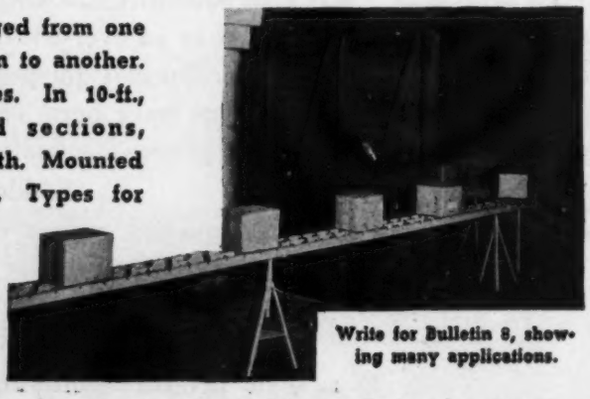
**ASK FOR CATALOG No. 200**

**Utilize man-power to its greatest advantage . . . Move loads on conveyors . . . Avoid handling and rehandling . . . Save steps . . . Keep work and materials flowing . . . BUSCHMAN designs, builds, and installs complete conveyor systems to meet individual material handling requirements . . . Have you a handling problem?**

## NEW PORTABLE CONVEYOR

### *Speeds Package Handling*

**Quickly, easily changed from one location or application to another. Versatile in its uses. In 10-ft., straight and curved sections, coupled to any length. Mounted on easels or tripods. Types for light or heavy packages. Durably built. Low in cost.**



**Write for Bulletin 8, showing many applications.**

## THE E. W. BUSCHMAN COMPANY, INC.

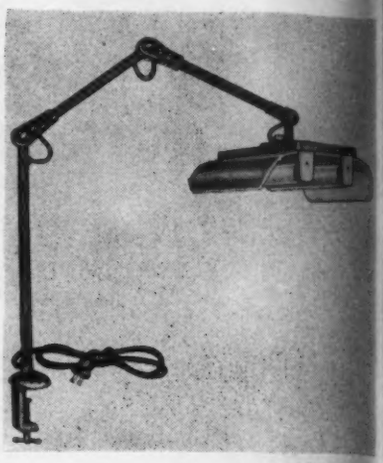
*Engineers & Manufacturers*

**419 New St. Cincinnati, Ohio**


shanks are 0.25 inch in diameter and the burring tools are 2¼ inches over-all. Carbur, Inc., Lincoln Park 25, Mich.

## Localized Lighting Unit

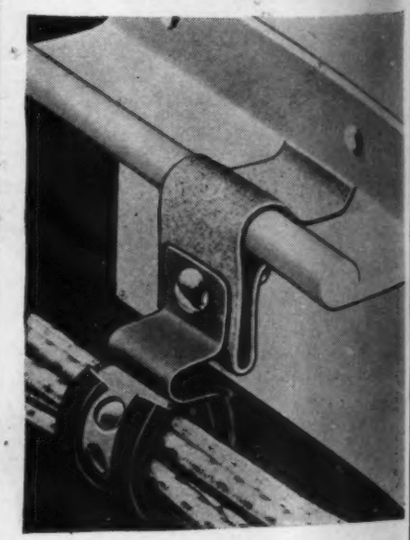
Fluorescent localized lighting unit FLB has a variety of arm lengths for positioning requirements. It accommodates two 14-watt fluorescent lamps, is equipped with lamp ballast, and comes completely wired

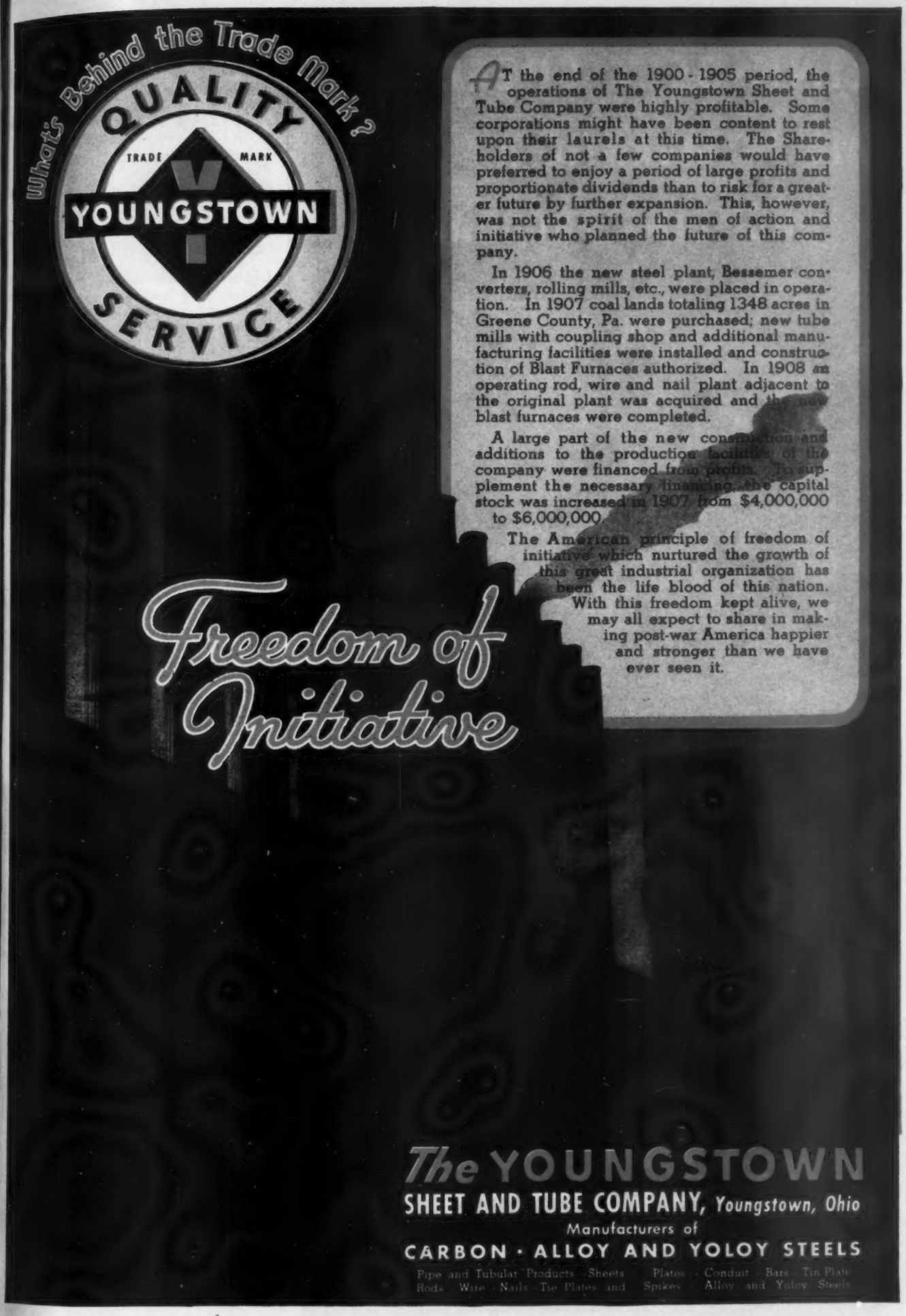


with switch mounted onto the housing. Housing is 22-gage steel. Reflector of non-metallic material is 15 1/16 inches long, 9 inches wide, and 5⅜ inches high. Outside finish is wrinkle gray, inside reflector finish is gloss white. Furnishes in excess of 100 foot-candles of light. The Fostoria Pressed Steel Corp., Fostoria, Ohio.

## Latching Wire Harness Clamps

Wiring harness clamps with a latching finger have been released for use in aircraft and other equipment. These clamps work independently of the attaching screw in the assembly of wire harnesses. Any or all the wires may be removed or replaced without loosening the screw that holds the clamps in position. Clamps remain snapped over the wires during transportation to final assembly location, serving as mounting means for attaching harness to




What's Behind the Trade Mark?
QUALITY
TRADE
MARK
YOUNGSTOWN
SERVICE
Freedom of Initiative
AT the end of the 1900 - 1905 period, the operations of The Youngstown Sheet and Tube Company were highly profitable. Some corporations might have been content to rest upon their laurels at this time. The Shareholders of not a few companies would have preferred to enjoy a period of large profits and proportionate dividends than to risk for a greater future by further expansion. This, however, was not the spirit of the men of action and initiative who planned the future of this company.
In 1906 the new steel plant, Bessemer converters, rolling mills, etc., were placed in operation. In 1907 coal lands totaling 1348 acres in Greene County, Pa. were purchased; new tube mills with coupling shop and additional manufacturing facilities were installed and construction of Blast Furnaces authorized. In 1908 an operating rod, wire and nail plant adjacent to the original plant was acquired and the new blast furnaces were completed.
A large part of the new construction and additions to the production facilities of the company were financed from profits. To supplement the necessary financing, the capital stock was increased in 1907 from $4,000,000 to $6,000,000.
The American principle of freedom of initiative which nurtured the growth of this great industrial organization has been the life blood of this nation. With this freedom kept alive, we may all expect to share in making post-war America happier and stronger than we have ever seen it.
The YOUNGSTOWN
SHEET AND TUBE COMPANY, Youngstown, Ohio
Manufacturers of
CARBON · ALLOY AND YOLOY STEELS
Pipe and Tubular Products · Sheets · Plates · Conduit · Bars · Tin Plate
Rods · Wire · Nails · Tie Plates and Spikes · Alloy and Yoloy Steels

# LINK-BELT SPEEDERS AID IN GIGANTIC AIRCRAFT BUILDING PROGRAM

One of four Link-Belt Speeders used in unloading aluminum-bearing bauxite from barges and stocking it along the dock.

Speedy finger-tip control, added strength, greater mobility and rapid booming assure rugged, efficient performance that is virtually maintenance-free. These are the Link-Belt Speeder qualities that are recommending these machines wherever it is necessary to load, unload or handle materials quickly and efficiently. The job doesn't come that's too tough for the Link-Belt Speeder—and there is a model for every type and capacity of job.

*Keep 'em Rolling and Keep 'em Flying*

**LINK-BELT SPEEDER**

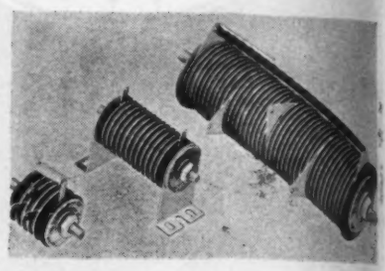
BUILDERS OF THE MOST COMPLETE LINE OF SHOVELS—CRANES—DRAGLINES

LINK-BELT SPEEDER CORPORATION, 301 W. PERSHING ROAD, CHICAGO, ILL.
(A DIVISION OF LINK-BELT COMPANY)


structure. Made of spring steel parkerized and given two coats of lacquer, they are cushioned with extruded synthetic rubber channels having integral resilient ribs to absorb variations in thickness of harnesses. Two different latching stations are provided on each clamp for size adjustment to fit varying number of wires. Comes in six sizes which accommodate wire bundles varying from $\frac{1}{16}$ to $1\frac{3}{8}$ inches in diameter. Tinnerman Products, Inc., 2096 Fulton Rd., Cleveland.

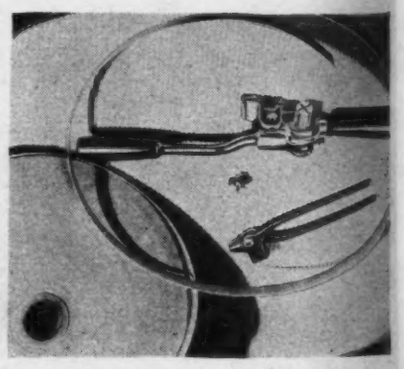
## Selenium Rectifier Stacks

Lightweight and small in size, selenium rectifiers have been improved so that better forward current characteristics and low leakage are responsible for higher operating efficiencies between the a.c. input and d.c. output. Mounting of selenium rectifier stacks in equipment can be accomplished in various ways. They can be bolt mounted or stud mounted directly to equipment assemblies. They are also available with mounting brackets of various types for convenient assembly to panels. General Electric Co., Bridgeport, Conn.



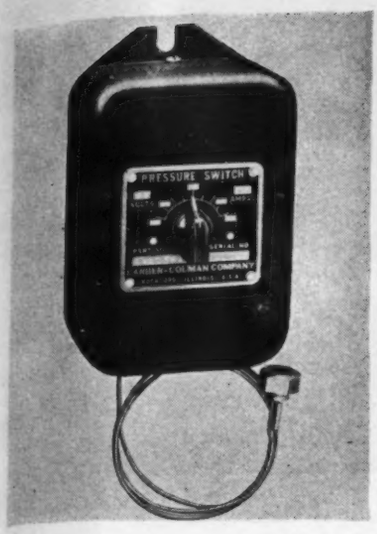
## Fiber Tape Strapping

Stur-D-Strap, a laminated fiber substitute for steel or wire strapping, can be used on all types of packages weighing 90 pounds or less, and in all types of steel strapping tools. Claimed water repellent, the tape has high tensile strength and only 1 percent elongation. Comes in 700-ft. rolls, $\frac{3}{4}$ inch wide. A. J. Gerrard & Co., 2700 Belmont Ave., Chicago.



## Pressure Switch

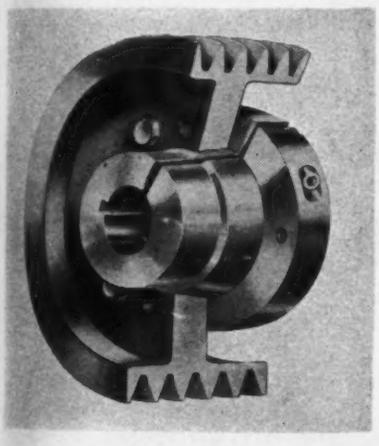
Micro pressure switch is a single-pole double-throw 3-wire instrument with positioning solenoid. Pressure sensitive bellows mechanism is mounted on a bakelite subbase and inclosed in a metal case for sur-




face mounting. Built-in condenser protects contacts. Has convenient external adjustment, or setting may be locked in place by means of internal locking screws. For 25-volt, 60-cycle control circuit, switches are available in ranges from 0 to 200 pounds. Barber-Colman Co., Rockford, Ill.

## Sheaves for V-Belt Drives

QD—quick detachable—sheaves for multiple V-belt drives are easily attached to or removed from the shaft with an ordinary socket wrench. The hub clamps firmly on the shaft, producing a virtual press fit on undersized or oversized shafts.

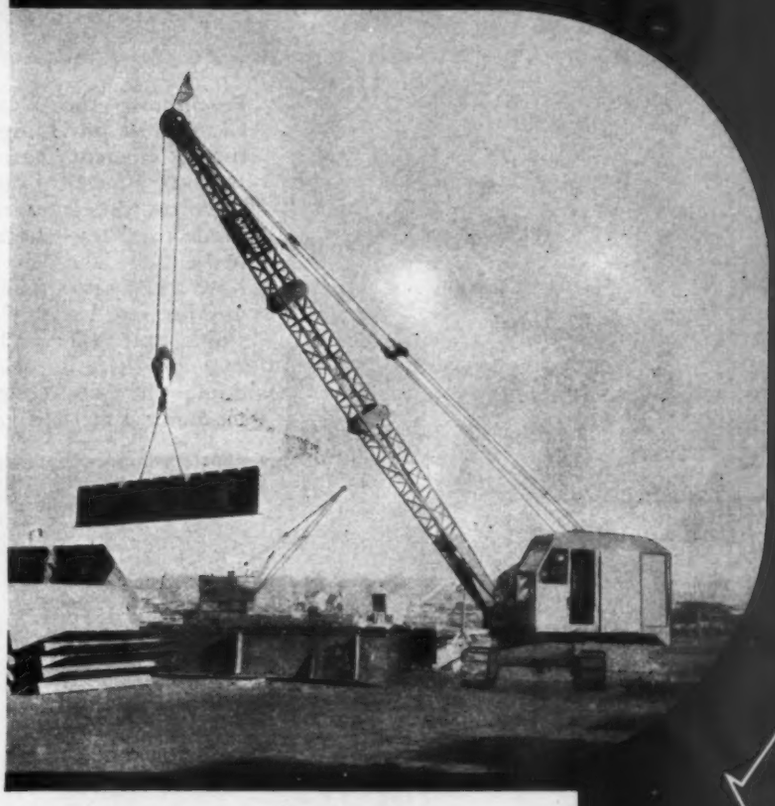


The hub remains permanently on the shaft assuring a pre-aligned drive. Seasonal speed changes are made by substituting sheaves of different sizes. According to the maker, no changes in engineering are necessary to switch from standard sheaves and bushings to QD sheaves. These are available in standardized QD sizes. Pyott Foundry & Machine Co., 328 N. Sangamon St., Chicago.

## Fluorescent Lamp Ballast

Ballast 240 B Streamliner is claimed to balance the light output and power consumption of two fluorescent lamps, 90 degrees out of phase. Lightweight, the Streamliner is easy to install. Dept. I, Superior Electrical Industries, 2614 W. North Ave., Chicago.

LINK-BELT SPEEDERS
MAKE THE TOUGHEST MATERIALS
HANDLING JOBS SEEM SIMPLE



Like so many match sticks, this Link-Belt Speeder LS-85 unloads fabricated sections which weigh up to 10 tons.

Link-Belt Speeders are furnishing production-minded plants throughout the country with fast, efficient means of loading, unloading or handling of materials! Link-Belt Speeder engineers have contributed many exclusive developments to the design of shovels, draglines, and cranes. Finger-tip control, added strength, greater mobility and rapid booming assure efficient day-in, day-out performance, that is virtually maintenance-free!

Keep on Buying Bonds and More Bonds!

9224

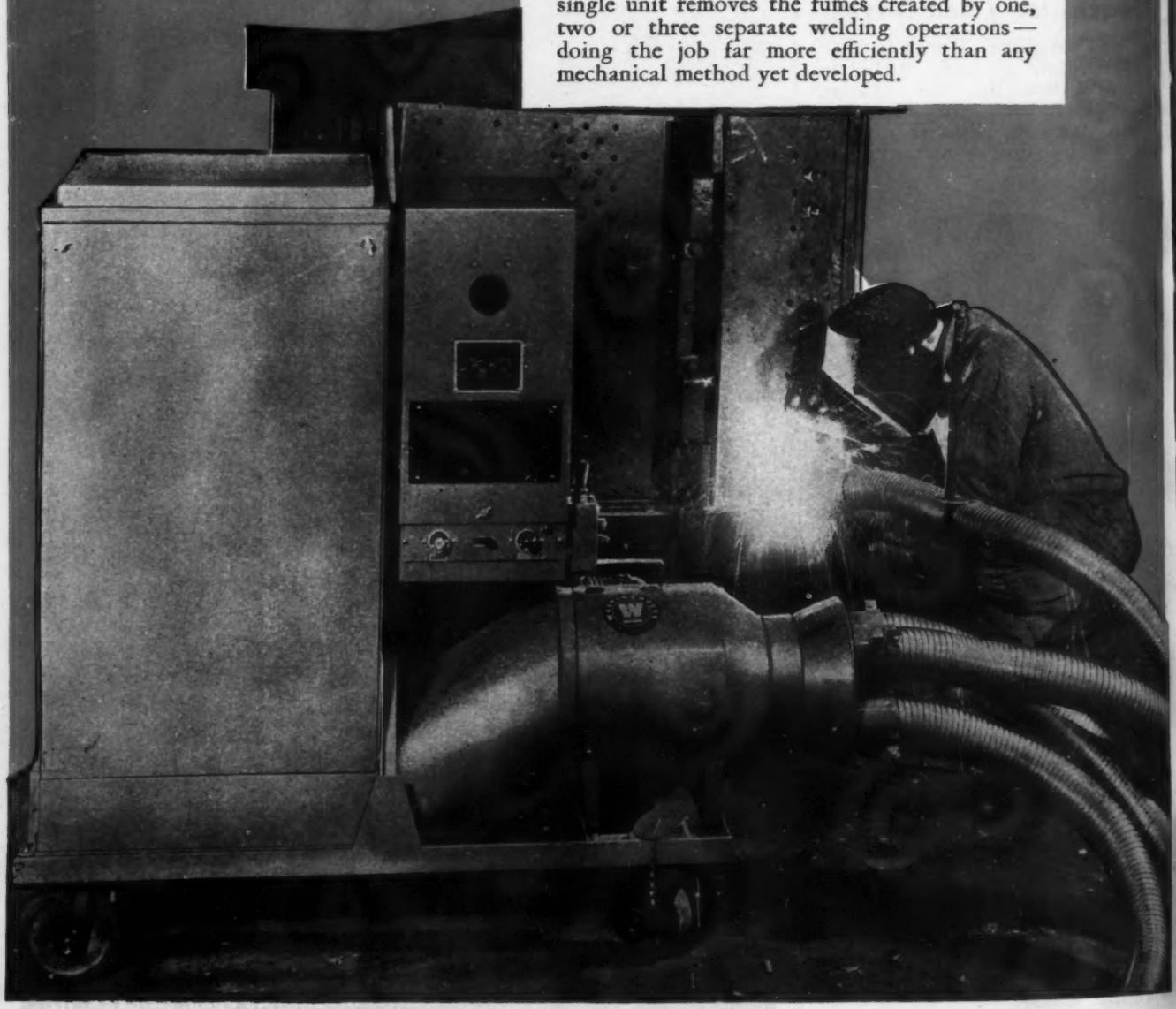
LINK-BELT SPEEDER

BUILDERS OF THE MOST COMPLETE LINE OF
SHOVELS—CRANES—DRAGLINES

LINK-BELT SPEEDER CORPORATION, 301 W. PERSHING ROAD, CHICAGO, ILL.
(A DIVISION OF LINK-BELT COMPANY)

# Electronics

**Precipitron**—the Westinghouse Electronic Air Cleaner—is providing industry with a new and highly efficient means for removing injurious welding fumes. It captures fumes and smokes at their source—removes more than 90% of airborne particles—particles as small as 1/250,000 of an inch. The new portable Precipitron units have a capacity of 600 cubic feet of air per minute. Equipped with three flexible metal hoses, a single unit removes the fumes created by one, two or three separate welding operations—doing the job far more efficiently than any mechanical method yet developed.



# FLUORESCENT LIGHTING . . .

RESTRICTIONS which WPB has established on the use of metals in fluorescent fixtures have been a challenge to the lighting industry. A challenge which the industry was more than ready to meet, but which presented almost insurmountable difficulties—coming as it did along with an acute shortage of lighting equipment for important war plants.

Long before the first WPB order, General Electric engineers had been working with fixture manufacturers to develop new fixtures using a minimum of critical materials. Last January, G-E announced that several types of non-metallic reflectors had been developed. Today, thanks to the ingenuity of the fixture manufacturers, a large selection of certified fluorescent fixtures, complying with WPB requirements and meeting the lighting industry's rigid specifications, are now available on priorities for war plants that need them.

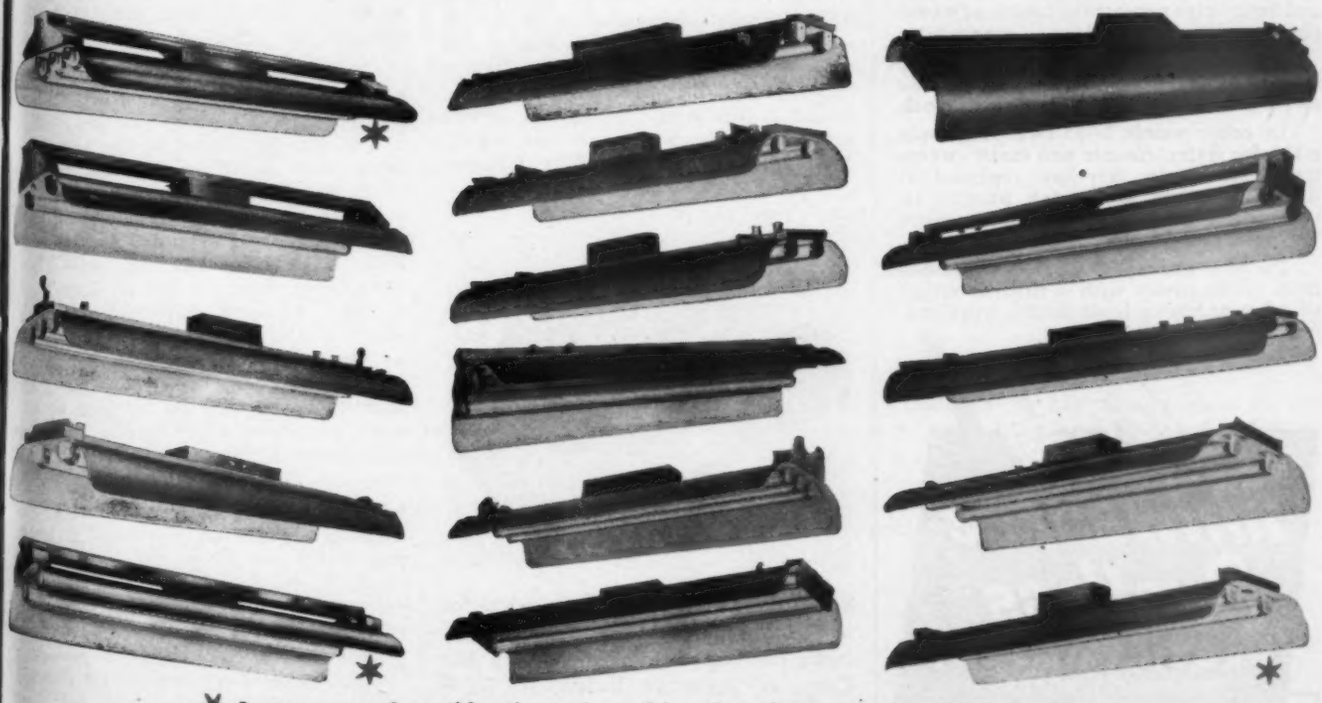
General Electric is proud of its share in this achievement—and G-E research will continue to work with fixture manufacturers toward making better and better lighting fixtures—for the duration and afterwards.

## *Now*... CERTIFIED FIXTURES ARE AVAILABLE FROM MANY MANUFACTURERS

**LIGHT—STURDY CONSTRUCTION . . . FOR CONTINUOUS ROW OR INDIVIDUAL MOUNTING . . . 2 OR 3-LAMP TYPES IN 40-WATT SIZE—2-LAMP 100-WATT SIZE**

Here are a few of the many different types of certified fluorescent fixtures available from the 50 Fleur-O-Lier and RLM Manufacturers through their wholesalers. All comply with WPB conservation orders and are made by manufacturers of ETL certified equipment. (*Names of these manufacturers on request.*)

***General Electric does not make lighting fixtures but is glad to recommend certified fluorescent fixtures.***



✱ *In process of certification when this advertisement goes to press.*

**G-E MAZDA LAMPS**

**GENERAL ELECTRIC**

**Maybe you've never looked at it in quite that way, but saving manpower is a large part of a sweeper's job. Put M-D sweeping tools into his hands and see what happens . . .**

**His faster sweeping prepares the way for extra production efficiency which, in effect, creates extra manpower.**

**His better control of germ-laden dust and litter helps protect the health of workers, guarding against loss of manpower.**

**His sweeping is done without waste motion and is less fatiguing. Thus the sweeper saves manpower in his own work.**

**In other words, M-D sweeping tools make for faster, cleaner and easier sweeping. That is why they have replaced ordinary brushes and push brooms in thousands of industrial plants since Pearl Harbor.**

**Put M-D brushes to work in your business. Your order with a priority rating of AA-5 or higher is all that is required.**

# YOU WANT TO KNOW

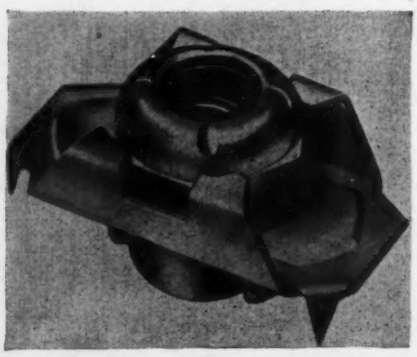
## more about the items mentioned on this page

### Letters to the addresses given will bring information

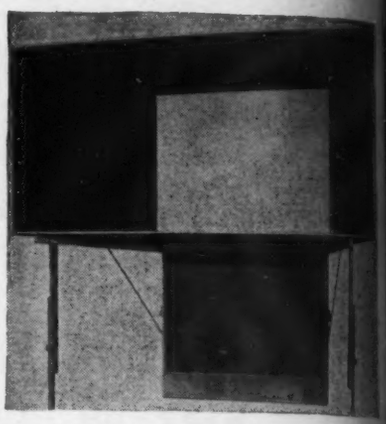
• "FOREMANSHIP and Accident Prevention in Industry" is a practical textbook for the supervisor who wants to supplement his knowledge of shop safety. Based on the day-to-day experience of safety engineers who work with every plan of production and safety organization in common use, the booklet contains chapters on causes of accidents; accident control in manufacturing methods; maintenance; housekeeping; personnel control in accident prevention; and aids to foremen. Published by Engineering Department, American Mutual Liability Insurance Co., Boston.

• TO PROMOTE a better understanding between the company and its employees National Gypsum Co., 325 Delaware Ave., Buffalo, N. Y., tells the story of the organization in an attractive 32-page booklet. Who owns the company, its markets, how its sales dollars are spent, how the employee fits into the scheme, and what is expected of him are some of the subjects considered.

• NON-FOGGING agent, compound MCG, prevents the formation of mist on eyeglasses, goggles, lenses, windows, and other glass surfaces. At the same time it removes dust, dirt, and fingerprints, and is said to remain effective as long as it is not removed by washing or wet wiping. Merix Photo Co., Wrigley Bldg., Chicago.



**SELF-LOCKING fastening device for use on plywood construction has been developed by Elastic Stop Nut Corp. of America, Union, N. J. A regular elastic stop nut, with red cellulose locking collar, is interlocked with a lightweight basket which anchors firmly in the wood. Spring fingers at the top of the basket clasp the nut, holding it against axial play. Can be affixed with a hammer or press, or drawn in with a bolt. The nut is replaceable without moving the basket, and 8/32 and 10/32 nuts are interchangeable in same basket**

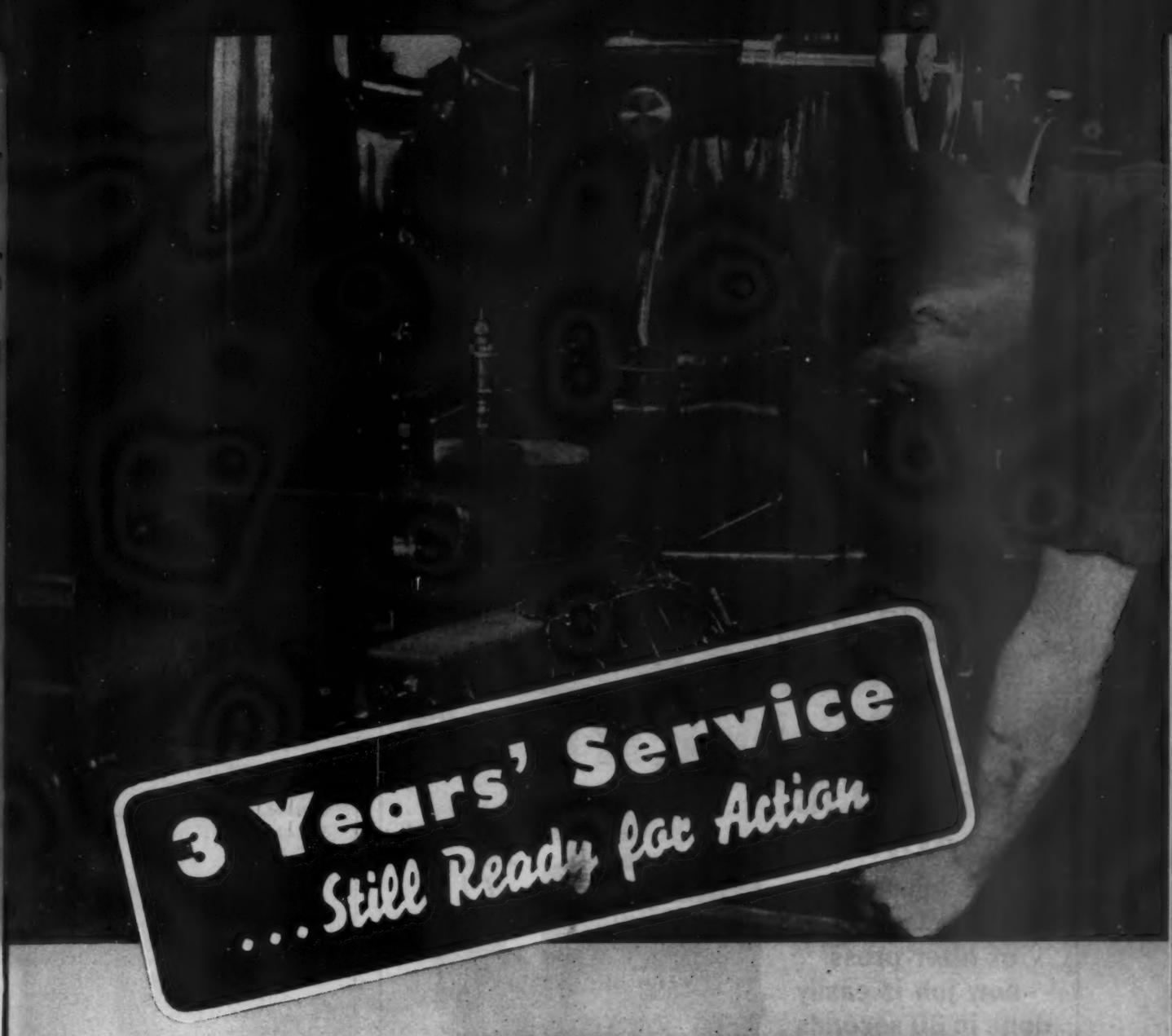


**RADIANT DAY-TIME projection box permits showing pictures in broad daylight by means of a shadow box construction. Pictures can be seen any place at any time. Easy to set up, the unit adjusts to four heights. Folds compactly and all parts fit into a storage case. Films or slides can be projected to audiences up to 150 persons. Radiant Mfg. Co., 1140 W. Superior St., Chicago**

• TWO MORALE BUILDERS. "What d'ya hear from the mob" by Joe Doakes is a booklet distributed by the non-profit organization Appreciate America, 130 N. Wells St., Chicago. It gives the reader a chance to sit in on a round-table discussion of the American people with Hitler, Goebbels, Goering, and Tojo. Mussolini is there too but he doesn't get to talk. How to undermine America's morale is the subject and the prize idea is "How to poison the American mind with hatred and lies." "I Know My Stuff!—do you?" also by Joe gives an animated picture of a 100 percent American looking out for the ole U.S.A.

• "EXIT INTERVIEW—An Aid in the Control of Personnel Turnover" is a 16-page leaflet put out by the War Department, Washington, D. C. It explains the purpose of the exit interview, which is to determine the true reasons why employees wish to resign and to provide a reliable source of information for management action, and outlines the best procedures for conducting the exit interview. An appendix shows forms for keeping a record of exit interviews.

• POSTERS-FOR-PRODUCTION booklet contains reproductions of 70 morale-building posters chosen as "representative of our war effort" from approximately 1000 posters submitted by 700 companies over the nation. Containing poster ideas from salvage to safety, the booklet tells from




# SOLNUS HYDRAULIC OILS

## Serve 14,976 Hours—*Plus*...Without Trouble or Change

Three years of continuous service without formation of sludge, in a machine that operates two shifts a day, is a mighty good record for *any* hydraulic oil. And when laboratory tests prove that oil is still in good condition for long, continued service, it's a record that's hard to beat.

That's exactly what happened in the plant of a well-known gear manufacturer in the Middle West. SOLNUS Light Hydraulic Oil served a total of 14,976 operating hours, over a period of 3 years, in a hydraulic broach used for finishing small gears. In all this time, there was not the slightest trouble with sludge or breakdown of oil.

Then a sample was carefully tested and compared with the original specifications. In flash, fire, viscosity, pour test and acidity there was scarcely any change from the original . . . and the SOLNUS Oil was in satisfactory condition for further service.

These facts speak for themselves. In many other cases on record, SOLNUS Hydraulic Oils have proved their ability to keep systems free of sludge, maintain uniform pressure, stretch time between cleanings and oil changes. A SUN "Doctor of Industry" is ready to show you how SOLNUS Oils can keep *your* hydraulic equipment on longer continuous work schedules. Write to . . .

**SUN OIL COMPANY, *Philadelphia***

*Sun Oil Company, Limited, Toronto, Canada*

**SUN INDUSTRIAL PRODUCTS**

SUNOCO

*HELPING INDUSTRY HELP AMERICA*

# Here's Another Tough Job Made Easy--At Low Cost!

# HEIN-WERNER

## HYDRAULIC JACK

**speeds up opening and closing of filter press -- now job is easily done in 30 seconds as against 10 to 20 minutes with gear and pinion**

Dual Operation of Two Speed Pumps is an outstanding and exclusive feature of 30 ton model.
HEIN-WERNER
HYDRAULIC
JACK 30.11A

(Model 30.11A)

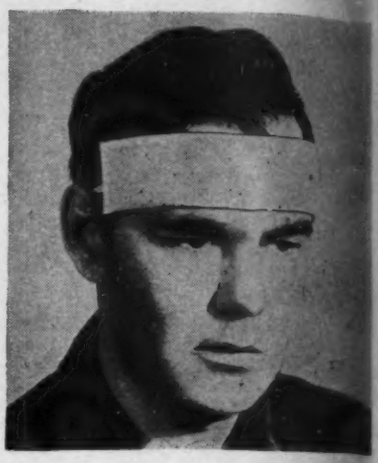
Have *you* ever thought of the many different uses your plant could make of Hein-Werner Hydraulic Jacks?

Applications are almost unlimited. For example—note the use illustrated above. Here, a well-known leader in the dairy products field advantageously uses a 30-ton capacity Hein-Werner Hydraulic Jack on a 36" Filter Press. The press illustrated, and three other H-W Jack equipped filter presses in this one plant, are held closed over four hour cycles under pressures up to 77,000 lbs.

The complete line of H-W Hydraulic Jacks includes super-powerful, easy-operating models of 3, 5, 8, 12, 20 and 30 tons capacity. Ask your industrial supply distributor, or write us for details.

**HEIN-WERNER HYDRAULIC JACKS**
*Are Built Right and Priced Right*


whom the posters and poster ideas are available, and gives data as to size, reproduction process, and designer. Booklet is sent upon request from National Association of Manufacturers, 14 W. 49th St., New York.



**SWEAT BAND**, claimed to provide a silky-cool non-irritating forehead contact, has an absorbent cellulose fiber filler with insoluble Aldex paper cover. Made to fit any head, the band keeps its shape, and is claimed rugged enough for rinsing, drying, and re-use. Aldine Paper Co., 375 Fourth Ave., New York

• WHITE PENCIL tracing cloth called Whitex is claimed moisture-resistant on both sides. It has a glass-like transparency and a fine-tooth surface which takes a black, sharp line. Samples of Whitex are available from The Frederick Post Co., Box 803, Chicago.

**PLASTIC TOOL CHECKS** are easy to read, soil-proof, waterproof, and can be written on with a china marking pencil. Come in many sizes with any type of printed matter desired. American Plastic Products, 553 S. Western Ave., Los Angeles

• TO HELP EMPLOYEES understand and evaluate payroll deductions of income taxes as well as social security, war bonds,

# THERE IS SOMETHING YOU CAN DO TO PREVENT WAR PLANT LIGHTING FAILURES

THE RLM LABEL HAS STOOD AS A SIGN OF QUALITY IN INDUSTRIAL LIGHTING REFLECTORS FOR MORE THAN 20 YEARS

● What would be the losses in war production if the lighting in your plant should fail? Production losses due to complete or partial blackouts result from many other causes than night air raids. Such "blackout" losses —which are as unnecessary as they are costly—result from (1) too little light for efficient seeing; (2) lighting that causes eystrain and fatigue; (3) lighting equipment that fails under severe service.

To guard against such lighting failures, insist that the industrial lighting fixtures you install are engineered and built to RLM Specifications. You can be certain you are getting this insurance against "war production blackouts" if your industrial lighting units are certified by the RLM LABEL.

Industrial Lighting Fixtures made in accordance with RLM Specifications...and certified by the RLM LABEL...are designed and constructed with that extra safety factor so vital today. They also provide highest lighting efficiency, maximum power conservation, lowest maintenance cost. Their reflectors of pocelain enamel ...the most practical of all known reflecting surfaces for most industrial lighting purposes... are unaffected by mechanical strains, smoke, fumes, grime, dust and atmospheric conditions... are non-porous, easily cleaned, fadeproof, non-peeling and non-breakable. For full particulars write any manufacturer or distributor of RLM Industrial Lighting Units, or RLM Standards Institute.

*The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers*

RLM STANDARDS INSTITUTE
INCORPORATED

307 N. MICHIGAN AVE. • SUITE 1600 • CHICAGO, ILL.

# Just for "DUCKS!"

MAYBE this idea isn't *practical*—but don't say it isn't *possible!* Shooting ducks with an automatically aimed and fired shot gun ought to be simple when you consider what the armed forces are doing today!

We don't know that duck hunters will ever have such a sure fire gadget. But we do know that when the fighting is over there will be countless new applications of electronic devices to do the world's work and to make living pleasanter.

Whatever form these electrical applications take, they will need connectors—similar to those Cannon now makes by the thousands, for use where vital electrical circuits must be connected quickly and easily.

The Cannon Type "K" Connector was designed for use in aircraft, radio, instruments and other electrical circuits. Besides their many wartime uses, Cannon Connectors are standard in a score of industries . . . in fact, you'll find Cannon Plugs used wherever electrical circuits must be connected or disconnected with 100% dependability.

**CANNON ELECTRIC**

**Cannon Electric Development Co., Los Angeles 31, Calif.**

**Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto**

*REPRESENTATIVES IN PRINCIPAL CITIES — CONSULT YOUR LOCAL TELEPHONE BOOK*


and other deductions, Nash-Kelvinator Corp,. Detroit, has issued a booklet titled "Your Hidden Treasure." It gives a clear, simple picture of where deductions go and what benefits they accrue. Tables are provided so that the worker can keep a running account of earnings and deductions. There are also charts for keeping a record of war bonds, home payments, insurance payments.

**STASAFE EYE MASK is an all-plastic eye protection, deep drawn to cover prescription lenses if necessary. The frosted area prevents reflection and distortion. Featherweight, the mask is durable, non-flammable. Made in large and small sizes, elastic and buckles at the temple make it adjustable. Can be refinished to eliminate minor scratches and abrasions. Standard Safety Equipment Co., 32 W. Ontario St., Chicago**

• TO THE MAN going into service, General Electric Co., Schenectady, gives a message of good will in booklet form. Items to take up with the company before leaving, such as re-employment, vacation allowance, group life insurance, and other business affairs, are suggested and discussed. Pointers are given on personal affairs which the inductee may have to attend to before leaving, and tips are given on what to do after he arrives in camp to make sure that all his affairs are in order.

• WAR DEPARTMENT Civilian Personnel Regulation 103 explains fully the policy and procedure for conducting an employee suggestions and cash awards program. The objective of this regulation is to "promulgate rules and regulations to make cash awards to employees for suggestions resulting in economy and improvement of manufacturing process or in the administration of the War Department; to stimulate through the making of cash awards the submission of ideas to eliminate waste, conserve manpower, and speed up production." Copies of the regulation are available from the War Department, Washington, D. C.

BUY WAR BONDS

**Proven on the proving grounds of war.**

**Clark Industrial Haulage Vehicles** are working wherever the United Nations have men.

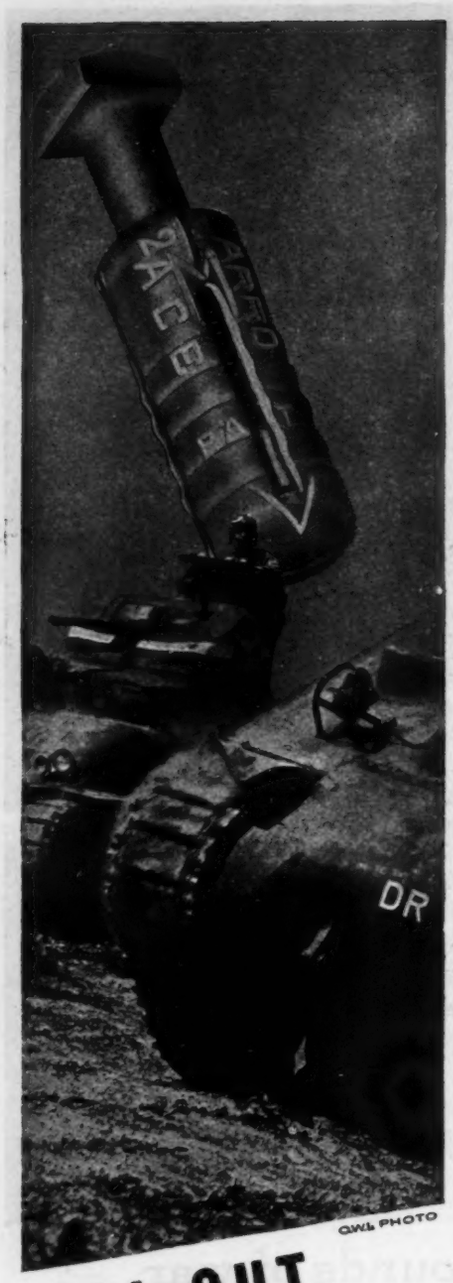
In the war production plants at home, Clark vehicles are "in there" handling tonnage to and from the production lines for shipments to the boys "Up Front".

ARMY E NAVY

CLARK TRUCTRACTOR

DIVISION OF CLARK EQUIPMENT COMPANY

BATTLE CREEK, MICHIGAN, U.S.A.




ALL OUT
for the
WAR EFFORT

TRADE ARRO MARK.

EXPANSION
BOLTS
AND ALLIED PRODUCTS

ARRO EXPANSION BOLT COMPANY
MARION, OHIO

# Significant Labor Developments

**Period Surveyed: June 10 to July 10**

## TREND INDICATORS

### *48-Hour-Week Ruling on Transported Workers*

WMC REQUIRES compliance with the 48-Hour Workweek Order by all employers seeking clearance for employment orders affecting workers to be transported from other areas. Such employers must observe the minimum work week even though they are not located in critical labor shortage areas or engaged in the steel, lumber, or nonferrous metal mining industries to which the 48-Hour Order has been made applicable on an industry-wide basis. The only exceptions permitted are in the event that it is impracticable in view of the nature of their operations, or lengthening the work week would not reduce their labor requirements. Even where it is impracticable, the work week is to be lengthened to the extent feasible.

### *Held Time Worked*

Time required for change of clothes is held compensable under the Wage-Hour Law. (Ruling of Wage-Hour Administrator)

### *Deduction Disallowed*

An employer may not penalize an employee for failure to punch in or out on the time clock. Such deductions would constitute a profit to the employer in violation of the Anti-Kickback Act. (Ruling of the Assistant Solicitor of Labor)

### *Enforcing Subpoena*

Where it appears as if some of the employees are probably covered by the law, the court may exercise its discretion by ordering the employer to obey the subpoena without finally hearing and determining the question of coverage. If, on the other hand, the company is clearly not under the law, the court may decline to order compliance without first determining coverage. (Mississippi Road Supply Co. vs. Walling)

### *Held Not Under the Act*

A bus company operating busses between New York City and towns in New York and New Jersey, all within an area of 25 miles from New York City. (Gillette vs. Rockland Coaches, Inc.)

Vending machine firm selling coin-operated phonographs, pinball machines, and cigarette vending machines held exempt as retail establishment. (Walling vs. Sanders)

### *Victory Tax Taken From Back Pay*

Restitution of back pay under the Wage-Hour Law was held to be subject to the 5 percent Victory Tax, even though the payments were due for payroll periods prior to the effective date of the tax, January 1, 1943, unless the restitution was directed by the Wage-Hour Administrator and accepted by the employer prior to January 1, or a final court decree granting restitution was made before that time.

### *Jurisdiction of the State Court*

An action by employees, begun in a state court to recover back wages, cannot be removed by the employer to the federal district court, since it is the purpose of the Act to serve the interests of the employees, and their interests are best served if, having begun suit in a state court, the suit remain there until judgment. (Williams vs. United Mine Workers of America)

### *Application of Exemption*

The exemption from the Fair Labor Standards Act for service establishments Sec. 13(a)(2) is not limited in its application solely to those establishments which perform services for private individuals, but applies also to those that serve business enterprises. (Lonas vs. National Linen Service Corporation)

### *Application of Statutory Penalties*

The Wage-Hour law penalizes an employer for discharging an employee who files a complaint under the Act. The Act is directed not only against employers. Any person who had control of the company's business would likewise be liable since the statutory penalties are applicable "to any person," it being immaterial whether he is an employer. (Meek vs. U. S.)

### *Labor Laws Relaxed*

Connecticut, Ohio, and Texas laws permit a longer work week for women. The Texas law provides for a 9-hour day and a 54-hour week, with provision in most occupations for overtime at double rates. California, Connecticut, and Pennsylvania now have more liberal laws.

### *Blacklist Penalty Continued*

Destruction of the time records, held to be part of a scheme to escape payment of the minimum wage rates established under the Walsh-Healey Act, justified continuing the blacklist penalty.

(*Continued on page 248*)

## Amazingly Fast . . . Safe . . . Thorough

*Setol* is an oil emulsifier—*it breaks down oils*—hence the speed with which it penetrates and removes stubborn coatings of grimy oil and grease.

Though best known for its wonderful cleansing action on hard-to-clean mill and factory floors, *Setol* has proved equally effective for cleaning heavily soiled painted walls and ceilings. It's thoroughly safe . . . free from harmful properties that *clean away* the finish and discourage repeated cleaning. *Setol-cleaned surfaces save frequent redecorating!*— a timely consideration. In man-hour savings, this *multiple-purpose product* pays for itself many times over.

*Setol* is both soluble and sudsless. And as a cleanser for use in scrubbing machines on mill and factory floors, it surpasses all other types. Compounded in *Finnell's* own powder mill, and sold in barrels, half-barrels, and quarter-barrels.

For literature or consultation, phone or write nearest *Finnell* branch or Finnell System, Inc., 2508 East Street, Elkhart, Indiana.

★ ★ ★

*The 600 Series Finnell* scrubs, waxes, polishes, steel-wools, sands, grinds. 5 sizes. Equipped with *Feather-Touch* Safety Switch. Available to essential users qualifying on Application Form PD-722.

**FINNELL SYSTEM, INC.**

*Pioneers and Specialists in*

FLOOR-MAINTENANCE EQUIPMENT AND SUPPLIES

BRANCHES IN ALL PRINCIPAL CITIES

**Number One cause of industrial accidents is FALLS. Many falling accidents are caused by slippery floors — floors soaked in oil or grease. You can effectively control this hazard in *your* plant by covering your oily floors with SPEEDI-DRI, which provides an immediate non-skid surface and rapidly *removes entirely* the film of oil that causes so many accidents. SPEEDI-DRI soaks up oil like a sponge, even drawing old oil from wood, concrete, or metal floors.**

If SPEEDI-DRI did nothing but reduce your accident experience, it would be well worth its moderate cost. But it does much more. Light in color, it improves plant visibility by light reflection. It saves workmen's shoes from oil-rot. It is an effective fire-retardant. Because it can be spread by hand and easily removed, it conserves vital manpower. It eliminates the need for expensive scouring. It does its work while the shop is in operation, without interfering with production for a moment. SPEEDI-DRI makes your shop safer, cleaner and brighter. Casualty companies actively recommend its use!

**SPEEDI-DRI costs less per square foot of floor coverage than any other effective method or product! For proof, send for a FREE SAMPLE of SPEEDI-DRI and test it yourself. (If you use water-soluble oils, or if water is also present, ask for SOL-SPEEDI-DRI.)**

**SPEEDI·DRI**
**OIL AND GREASE ABSORBENT**

UL

SUPPLIERS

East
REFINERS LUBRICATING CO.
New York 1, N. Y.

Midwest and South
WAVERLY PETROLEUM PRODUCTS CO.
Philadelphia 6, Pa.

West Coast
WAVERLY PETROLEUM PRODUCTS CO.
Menlo Park, Calif.

*Prompt Service from Warehouse Stocks in Leading Cities*


(Continued from page 246)

## WAR LABOR BOARD

### * *Authority of Industry Commissions*

The commissions established by the Bo in the various industries (trucking, st building, etc.) are now deemed on a with Regional Boards, so far as forma of decisions is concerned and right appeal therefrom.

### *Contract Will Not Be Set Aside*

WLB denied a union's petition fo maintenance-of-membership clause in v of the fact that the contract between parties does not expire until May, 19 The Board will not disturb an existi collective bargaining contract. (Brunsw Drug Company)

### * *Continued Operation Pending New Contract*

WLB, in adhering to its rule that c tracts must give way to the war effo ordered a company to continue operatio pending renegotiation of a new contra though the company had cancelled its c tract with the union because of stoppa and slowdowns. (Pullman Standard C Mfg. Company, Regional Board VI)

### * *WLB Suspends Contract*

WLB suspended parts of a valid collecti bargaining contract on the ground th such suspension was required by the w effort. In defense of its position, th Board pointed out that the Congress a the President never intended that t government should be powerless to act a situation merely because the action d manded was in violation of an existi contract.

The Board's order did not invalida the existing contract; it merely requir that a provision be held in abeyan pending a division by the proper agenc in this case the NLRNN. Until the latt determines the representation issue in que tion, the status quo is to be maintaine (Trailer Company of America)

### *WLB Directs Bargaining Agent*

WLB directed that the manager of restaurant be excluded from the bargai ing unit consisting of the other employee since the manager represents managemen (F. W. Woolworth Company)

### *Wage Stabilization*

Instructions to Regional Boards with r spect to steps in the determination sound and tested going rates and oth wage criteria:

Each region should establish a tripart division of the Regional Board to supe vise the work of gathering rates in th

* In this and the following classificatio items marked with an asterisk also a considered to be trend indicators.

...termination of brackets of sound and ...ted wages.

A wage rate bracket is defined as a range, ...m minimum to maximum, of stable ...ted rates for a given occupation in a ...en labor market.

Labor market areas should normally be ...sidered as single localities, "but there ...no hard and fast rule with respect to ...graphical or industrial coverage."

There is no inflexible rule by which wage ...e brackets can be determined, so that ...cisions in particular cases may be ex...dited by the establishment of tentative ...kets for key occupations involved, and ...Regional Board may, at its discretion, ...ke use of a weighted average for a ...en job classification by use of a desig...ted rule-of-thumb bracket.

### ...abilization Ruling

...age or salary increases made to comply ...h a state minimum wage law or order ...re accorded a special status by a ruling ...Economic Stabilization Director Vinson ...t such adjustments may be made effec...e when approved by the War Labor ...ard or one of its agencies, even though ...ices or rates may be affected.

### ...ividual Adjustment Rules Tightened

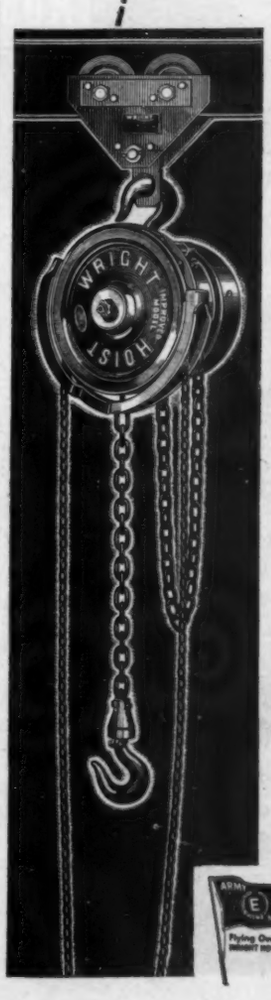
...t the Board further tightened rules on ...ividuals wage raises. Loosely drawn ...hedules or job classification rates based ...rely upon descriptive titles of positions ...ll not be approved. Moreover, job classi...ation rates or rate changes included in ...hedules must have been in existence ...roperly on May 31, 1943, the effective ...te of the Board's General Order No. ...1. Where no proper schedule existed ...n May 31, individual adjustments may ...t be made without prior approval until ...schedule is approved by the Board. In ...opting a plan for making individual ad...stments, an employer may not provide ...r both merit increases and automatic ...gth of service increases with respect ...a particular job classification.

### ...surance Premiums as Salary

...yments by an employer of premiums ...n life insurance covering the life of an ...ployee are considered salary for the pur...ses of the stabilization program to the ...ent that the payments amount to more ...an 5 percent of the employee's salary.

### ...OES Approves Increase

...ector of Stabilization Vinson approved ...LB's grant of an increase of 9 cents ...o elevated railway employees in Chicago, ...rt of which was necessary to restore ...e traditional relationship between their ...tes and those paid surface line em...oyees of another Chicago company. The ...sis for this increase was the directive ...f May 12, which authorizes wage or ...ary adjustments for workers in immedi...ely interrelated job classifications to the ...tent required to preserve the minimum ...differentials necessary for the maintenance ...f productive efficiency. Furthermore, no ...rice adjustments were involved in the




# INSPECT REGULARLY!

Don't neglect your **WRIGHT HOISTS.** Make them last longer by regular and proper maintenance. Here are a few suggestions:

**Put the grease gun to work!** A **WRIGHT HOIST** needs thorough lubrication once a month. Keep the load chain well lubricated, too.

**Don't overload your hoist.** While **WRIGHTS** are famous for their ability to stand abuse, this is no time to abuse machinery. Overloading results in a stretched chain which cannot seat itself properly in sheave pockets, thus accelerating wear.

**Watch the load hook. WRIGHT** hooks, drop-forged from special steel, give visible warning of overloading by slowly opening. Don't continue to use hooks that have stretched.

**Inspect your hoists regularly.** Remember: where properly maintained, **WRIGHT HOISTS** have given continuous, trouble-free service for 20 to 25 years.

*In Business for Your Safety*

**WRIGHT MANUFACTURING DIVISION**
York, Pa., Chicago, Denver, Los Angeles, San Francisco
Portland, New York
**AMERICAN CHAIN & CABLE COMPANY, Inc.**
BRIDGEPORT, CONNECTICUT

*And Now!*

# A COOLANT PUMP FOR SMALL MACHINES

A mounting bracket type pump that offers a choice of three outlets from which piping can be arranged to left, right, or back through the coolant sump. Mounted integral with heavy duty, long hour, totally enclosed ball-bearing motors, fully guaranteed by reputable motor manufacturers. Despite its diminutive size, it performs with the same high efficiency as its larger counterparts. Sealless type pump, operating with no metal - to - metal contact of moving parts. Designed especially for service on small machines such as grinders, drills, tapping machines, etc.

MODEL MVBD

BUY WAR BONDS

PIONEER PUMP & MFG. CO.
19644 JOHN R STREET
DETROIT 3 • MICHIGAN

increase, which was necessary to meet going rates established for surface line employees.

In its opinion on the case, the Board makes it clear that increases to correct intercompany inequities will be granted only where the following combination of circumstances exists:

1. A well-established and consciously maintained tradition to preserve definite relationships between wage rates paid by various companies in key occupations.
2. An act of the Board undertaken in an effort to stabilize the industry which has altered that relationship.
3. A demonstration that the increase sought is required to restore minimum differentials necessary to productive efficiency.

### * *Stabilization Formula*

WLB ordered an increase for Michigan and Wisconsin lumber men above the Little Steel formula, but denied an increase up to the formula for some 5000 New York City compositors. In the latter case a 7.15 percent increase had been granted December, 1941, and although 7 percent was recommended by the referee, making an increase of $4.20, it was rejected as having an unstabilizing effect; $2 a week was approved. In defense of its position, WLB said that the 15 percent limitation had been invoked when the peacetime standards of the employees involved in a case were relatively very high compared to other employees in related work and where further general increases would create unstabilizing inequalities rather than adjust inequalities.

In the case of the 3000 workers employed by the Michigan & Wisconsin Lumber Company, the increase allowed, while above the Little Steel formula, was not deemed so high as to make their work more profitable than work in nearby mining towns. The factor justifying the increase was "a major economic change" brought about by the abnormal war demand for birch and maple, changing the industry from an "orphan" industry to an important war enterprise. (Michigan & Wisconsin Lumber Co., N. Y. Employing Printers' Association)

### * *WLB to Enforce Stabilization*

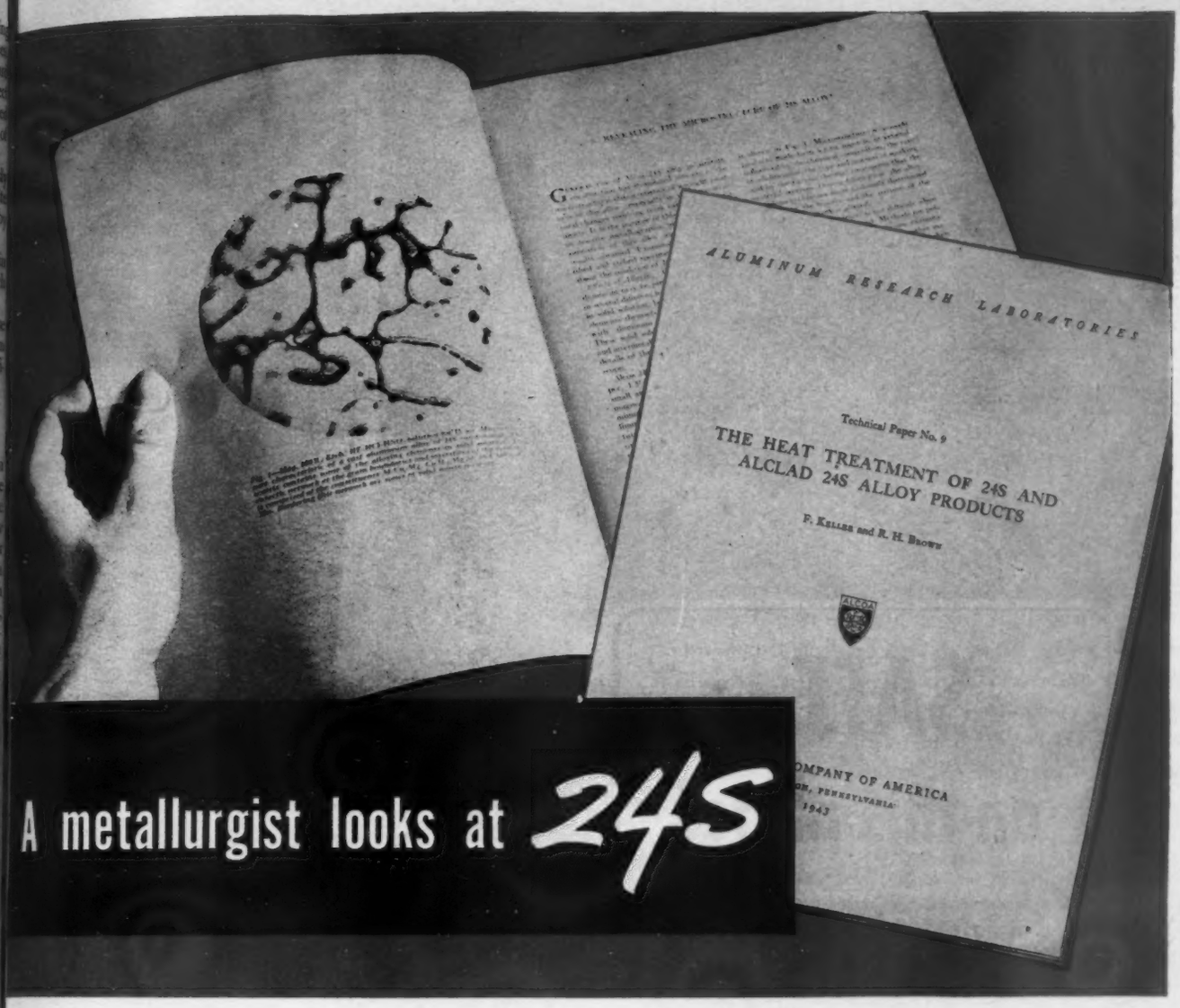
WLB announced that 2369 violation complaints have been filed with the Board and its Regional offices and many more will be filed. Wage-Hour Division inspectors will make spot checks and investigate payrolls when particular complaint has been made.

### *Substandard*

In determining whether wages paid are substandard, WLB uses the average rate for similar work in other industries in the area. Accordingly, WLB granted increases even though they brought the rates above the average rates in the industries affected. (Associated Laundries, Inc.)

### *Increases Granted*

WLB granted a 5 percent increase to eliminate inequalities between the rates paid the employees involved and those paid comparable employees of other similar


ALUMINUM RESEARCH LABORATORIES
Technical Paper No. 9
THE HEAT TREATMENT OF 24S AND ALCLAD 24S ALLOY PRODUCTS
F. Keller and R. H. Brown
ALCOA
A metallurgist looks at 24S

Aluminum alloy 24S is used in aircraft construction for parts subjected to high stress; 24S and Alclad 24S sheet and strip for airplane skin and structural members, 24S wire for rivets. Parts made of this alloy are hardened and strengthened by heat treatment.

Technical Papers No. 8 and No. 9, pictured above, tell how you can check the effectiveness of heat treatment. Metallographic methods of examination and the results obtained are outlined. You can detect variations from standard practices by comparing samples taken from your production with those pictured in these papers.

Practices described have been used at Aluminum Research Laboratories and in the industry for many years. When these methods are followed closely, and the proper skill attained, it is possible to determine many pertinent facts about 24S from metallographic examinations. Your metallurgist should have these two booklets.

For copies of Technical Papers No. 8 and No. 9, write ALUMINUM COMPANY OF AMERICA, 2126 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

LIKE the base-stealer's spikes, Multigrip risers bring sure footing to the slick soles of plant workers.

Other advantages? . . . Low first cost, speedy installation, reduced wear and tear on vehicles and on floors. With U·S·S Multigrip Floor Plate, shooting mainly for safety, you increase structural strength and also bring down costs.

The Multigrip tread insures comfort, reduces fatigue, provides traction in every direction—wet or dry. Even narrow-tired trucks roll smoothly. Floor life is lengthened, cleaning is quick and easy, water drains off promptly.

Put a ceiling on flooring costs—reduce accidents—with low cost, minimum maintenance Multigrip Floor Plate.

ONE AIM . . . VICTORY . . . BUY BONDS!

**U·S·S MULTIGRIP FLOOR PLATE**

CARNEGIE-ILLINOIS STEEL CORPORATION
*Pittsburgh and Chicago*
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

companies, on the ground that it was an "adjustment leading to the elimination of substandards."

An increase of 10 cents, though approved by the West Coast Lumber Commission, was reduced to 7½ cents when the company indicated that it would seek to pass the increase on through a rise in price. The 7½-cent increase an hour, to be applied on an industrywide basis, was expected to have a stabilizing effect by re-establishing previously existing differentials between rates in the Redwood and fir industries. (Hammond Redwood Co.)

An increase was granted to clerical workers to bring their wage rates into line with sound going rates for comparable work in the industry (Toledo, Peoria & Western Railroad), and to employees of a telegraph company on a broad basis, which though seldom allowed, was required in this case "to keep the minimum differentials between immediately related job classifications necessary for the maintenance of productive efficiency." (Postal Telegraph Cable Co.)

An increase was also granted in the form of incentive wages for the salmon industry, as an essential activity. (Alaska Salmon Industry, Inc.)

### *Differential Abolished*

A southern employer was directed to abolish pay differentials between white and negro workers. (Southport Petroleum Company of Delaware)

### *Increase Denied*

However, a wage increase was denied where all classifications were covered, since the employer's scale of unskilled labor exceeded the minimum "sound and tested going rate for such labor in the area." (Clark Controllers Company)

### *Bonus Denied*

The Cleveland WLB denied approval to an attendance bonus since it tends toward inflation and would not prevent absenteeism. Furthermore, one is not entitled to pay for that which he is already legally bound to do. (Quality Body & Top)

### * *Holiday Premium*

Where the holiday falls on Sunday but is celebrated on the following Monday, the premium rate may be paid for either day, but not for both. The choice is up to the parties affected.

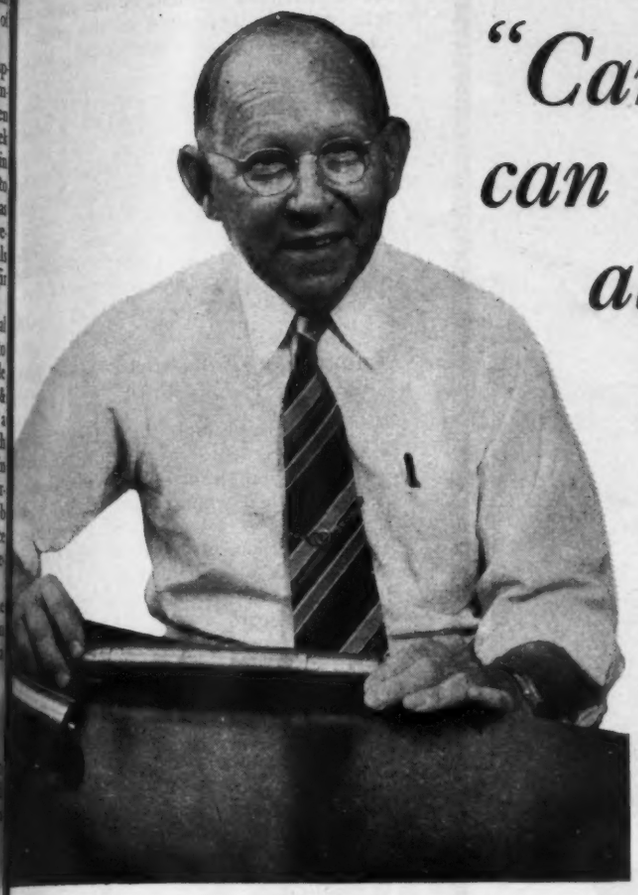
### * *No Pay for Holidays Not Worked*

WLB denied a union's request for compensation for holidays which were not worked. The question is properly a matter to be determined through collective bargaining. Such an award would constitute an increase not authorized by WLB. (Pittsburgh Plate Glass Company)

### * *Vacation Offset*

Extra compensation in lieu of vacation may be paid without prior approval to salaried employees receiving not more than $7500 a year. But the vacation policy

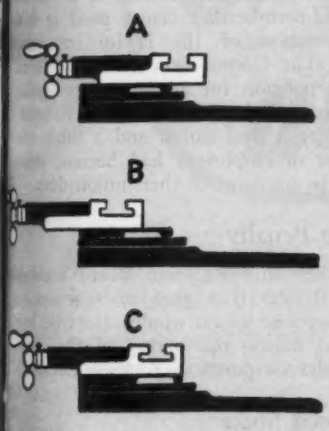
CUTTING TOOL TIPS FROM THE TOP-NOTCHERS—#6



# *"Care in rough cutting can save valuable time all along the line."*

**Says FRANK C. LANG, Superintendent**
**THE R. K. LeBLOND MACHINE TOOL CO.**
**Cincinnati, Ohio**

• Many new lathe hands, even some old-timers, consider rough turning a kind of hacking process that doesn't call for much brain work or care. While roughing isn't directly as important as finishing, there are many places where an operator can avoid needless waste of material . . . save himself and others valuable minutes by remembering a few simple do's and don'ts.




**"In rough cutting care should be taken to have the compound rest in the proper position. In both positions, Fig. 'A' and Fig. 'B,' a break could result in the middle of the tee slot. Fig. 'C' is correct. When making heavy cuts, top slide should be flush with bottom slide so all metal is in compression.**

**CHART FOR CEMENTED CARBIDE TOOLS**

| KIND OF MATERIAL | CUTTING SPEED Ft. per Min | DEPTH OF CUT Inch | RATE OF FEED Per Rev |
|---|---|---|---|
| CAST IRON | 210 | 3/8 | 0.062 |
| SEMI-STEEL | 280 | 1/8 | 0.012 |
| TOOL STEEL | 140 | 1/2 | 0.020 |
| BRONZE | 425 | 3/16 | 0.024 |
| BRASS | 458 | 3/32 | 0.108 |
| ALUMINUM ALLOY | 570 | 1/8 | 0.031 |

**"There is a tendency for many lathe operators to work their machine far below top efficiency because they fail to take a deep enough bite. Where tool failure is the limiting factor in size of roughing cut, it is usually possible to reduce the speed but increase the feed to such an extent that the amount of metal removed is greater than when operating at a faster clip. When using carbide type tools, the figures shown in above chart can be used for a general guide.**

**"In rough turning, hard-to-replace tools are often neglected because the operator thinks he can get by with a tool so dull that it actually is pushing the metal off instead of cutting it off. The best method for grinding tools is by the semi-automatic grinding machine. To cut free, a tool must be ground with four correct angles—side clearance, back rake, side rake, and end clearance. Refer to a tool manufacturer's manual."**

Care in the selection of your cutting oil is as important as care in lathe operation. That's why Shell has developed a control technique that "balances" the oil to the machine, the application and the tool. Call in the Shell man now for details.

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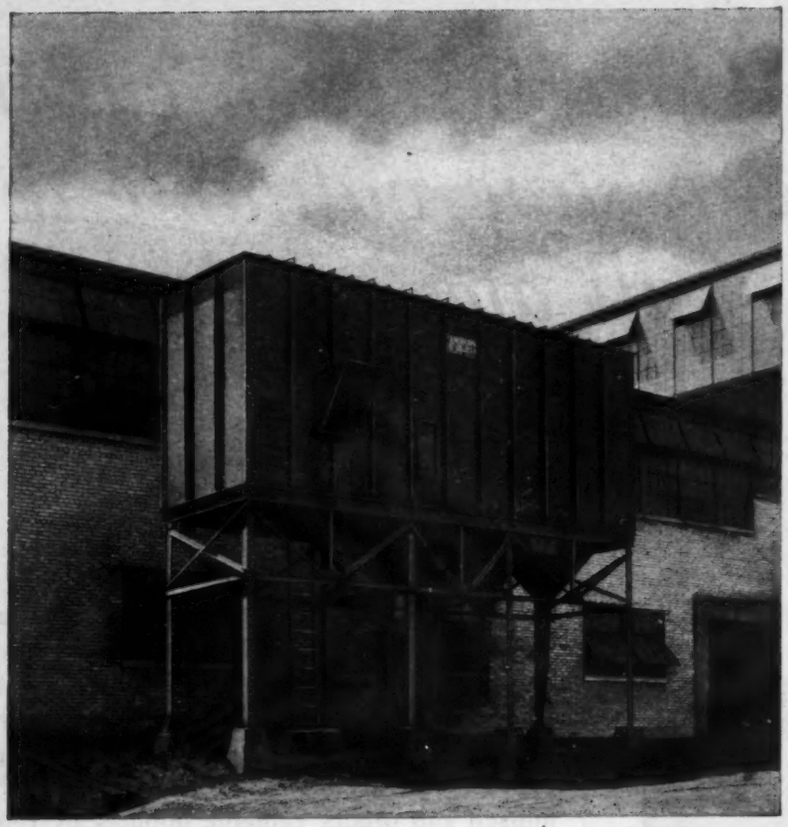

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must have been established prior to October 3, 1942, and payment for the vacation time must be computed at the present rate of the normal (unextended) work week.

Employees who work rather than take a scheduled vacation are entitled to extra pay without Board approval. Such extra pay does not constitute a wage increase since it does not increase the employee's hourly rate. In fact, failure to give extra pay would result in a decrease in the hourly rate in violation of the stabilization program. (Regional War Labor Board)

### *Stabilization Adjustment Under the Railway Labor Act*

In the first award under the Railway Labor Act an adjustment was made to conform with the stabilization policy. This award is distinguished from earlier ones also in that, instead of being merely an advisory recommendation, it becomes effective in 30 days unless the Director of Economic Stabilization orders otherwise. (National Mediation Board)

### *Appeal Deferred*

A tie vote of the Supreme Court leaves in effect a decision that awards of the Railroad Adjustment Board under the Railway Labor Act may not be judicially attacked by employers for a period of two years.

### * *Renewal of Union Security Denied*

WLB's Lumber Commission rejected a union's demand for renewal of a maintenance-of-membership clause pending final determination of the lawful bargaining agent. The Commission specifically found that a petition for an employee election had been filed with the Labor Relations Board by a rival union and a substantial number of employees had become delinquent in payment of their union dues.

### *Strike Penalty*

The Cleveland Regional Board withheld from strikers that part of a retroactive wage increase which would otherwise have accrued during the period of the strike. (Chrysler Corporation, Airtemp Division)

### * *Closed Shop*

WLB ordered a strictly closed-shop provision to be renewed. However, for those employees who were hired between the expiration date of the old contract and the execution of the new contract, only a standard membership-maintenance clause should apply. (Public Service Bass Co.)

### * *"No Lockout" Guarantees Labor's Rights*

WLB reads management's "no lockout" pledge as a guarantee that it would afford to labor the rights of labor, including those under the Wagner Act. Management's refusal to recognize and bargain with a union certified by NLRB on the ground that procedure under the Wagner Act had not been exhausted was ruled a peacetime lur-

# WAR WORK Begins at 40

## For these B & W BOILERS

At the ripe age of 40, five of these central-station B&W boilers of 1902 were recently drafted for work in a Southern war plant, thereby saving critical materials that would have been required in the construction of new boilers for this service.

A lot of steam flowed from their charcoal-iron, hammer-welded tubes since they were first placed on the line, yet, when they were given a careful "physical" this year by the inspectors, they were pronounced hale and hearty, ready for induction into war service.

This fact testifies not only to the soundness of their design, but to the excellence of the materials and workmanship that entered into their construction 'way back in 1902—always a matter of pride with the manufacturers of B&W boilers. It also testifies that the boilers must have received excellent care from their operators.

And these are only five of many B&W boilers, that, after long and useful lives in other fields, are being drafted for re-installation in war industries, where, incidentally, they will continue to receive the benefits of B&W engineering and service.

***"VICTORY is a job for steam . . . and steam is a job for B&W."***

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THE BABCOCK & WILCOX COMPANY, 1881

G-252

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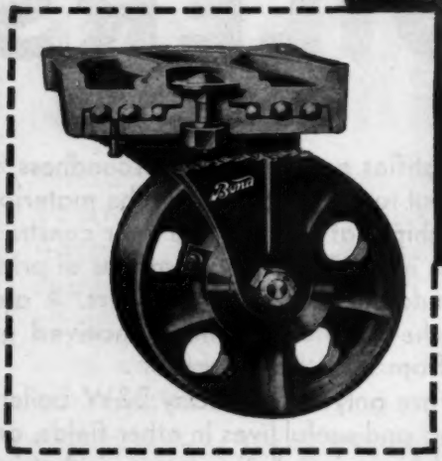
**BOND 36-A CASTER** (above)—Basically different in design, this caster combines easy swivelling with long service. The "reason why" lies in the arrangement of its ball races and its use of durable Bond Caster metal. Pressure lubricated throughout.



**BOND 40-A CASTER** (above)—The preferred light-weight caster for heavy duty. Sturdy, all steel construction reduces caster breakage . . . cracking . . . or excessive wear even under peak loads. Swivels with frictionless ease. Pressure lubricated throughout.

**BOND 118-A CASTER** (left)—Triple ball race caster for heavy duty and unusually hard service. Two large diameter, machine finished outer races carry the load; inner race absorbs all side shock. Cupped raceways assure even wear and long life. Pressure lubricated throughout.

**BOND FOUNDRY & MACHINE COMPANY, MANHEIM, PA.**

# Bond* TRUCK CASTERS

* Reg. U. S. Pat. Off.


ury, which WLB would not countenance in a war economy. (J. I. Case Company

### *Enforcement Limited*

WLB's orders were held to be merely advisory and enforceable only on order of the President. (Baltimore Transit Co. v. Vlynn, D. C., Md.)

## NATIONAL LABOR RELATIONS BOARD

### *Wagner Act Applies Despite Government Supervision*

Although a firm is producing exclusively for the government under the supervision of a government agency, it must still comply with the Wagner Act. (National Tool Company)

### * *Held Independent Contractors*

The Circuit Court of Appeals of San Francisco ruled that news boys are not employees within the meaning of the Wagner Act, but independent contractors, and hence not entitled to employee rights under that Act. Evidence of the independent contractorship status is found in the fact that if a newspaper is destroyed or stolen the loss falls on the newsboy and his pay is the difference between the wholesale and retail price of the paper. (Hearst Publications, Inc.)

### *Election Ordered*

The fact that a union has a "no raiding" clause in its agreement did not prevent the Labor Board from directing an election for choosing between the petitioning union and a union which had a closed shop. (Caesar Manufacturing Company, Inc.)

### * *Right to Refuse Delivery*

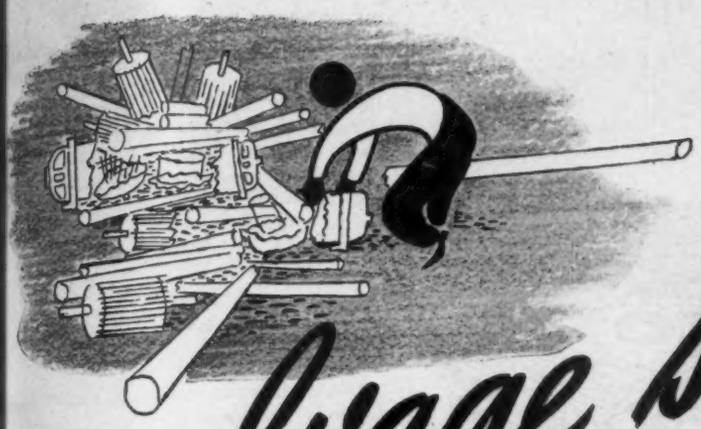
Carriers operating under a closed shop and physically prevented from picking up and transporting commodities because of a strike were held not to have been guilty of unlawful refusal under the Interstate Commerce Commission. (Montgomery Ward & Co., Inc. vs. Consolidated Freightways, Inc.)

### * *Union Activity Restricted*

Union activity may be curbed when the restriction is reasonably designed to promote plant discipline and efficiency, though it may not be applied to employees on their own time. On the other hand, the Board found it necessary to the mutual aid and protection of union members working on shipboard that they be enabled to pay their dues, have assistance in settlement of grievances, and receive their union papers. Membership, however, could not be solicited. (Scullin Steel Company; Richfield Oil Corporation)

### * *Management's Right to Fair Hearing*

A Circuit Court of Appeals set aside an order of the NLRB on the ground that



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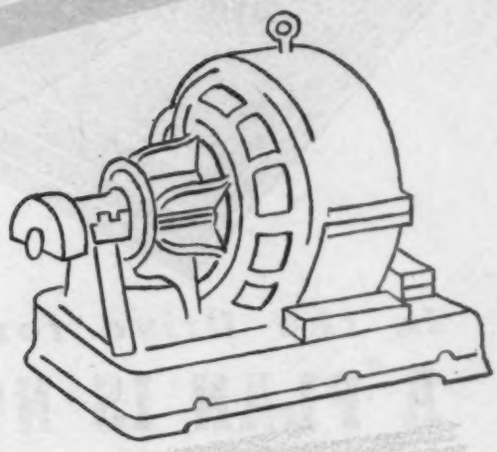

## to replace broken shovel motor-shaft in one day's time

SHAFT ON 37 HP SHOVEL MOTOR SNAPPED AT 4:00 P.M. FRIDAY. MOTOR RECEIVED AT WESTINGHOUSE DISTRICT MANUFACTURING AND REPAIR PLANT 11:00 A.M. SATURDAY. STEEL FOR NEW SHAFT COULD NOT BE DELIVERED PROMPTLY. SEARCHED SALVAGE AND MACHINED LARGER MOTOR SHAFT TO CORRECT DIMENSIONS. MOTOR ASSEMBLED AND SHOVEL OPERATING AT 4:00 P.M. SUNDAY.

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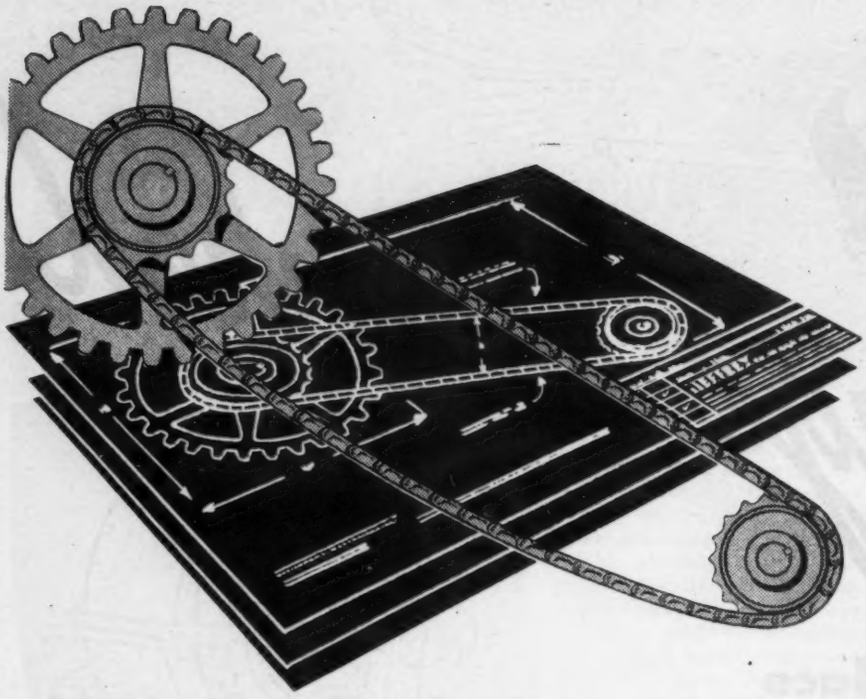
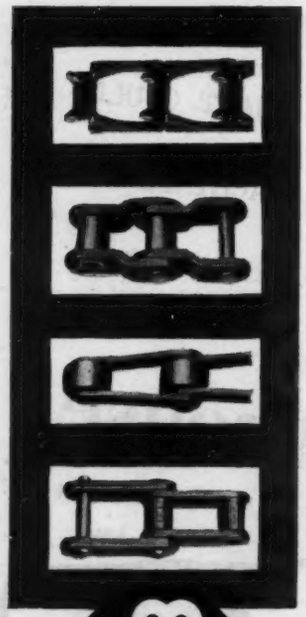


*In the Drive for Production*

**A PLAN IS NO BETTER THAN ITS *PARTS***



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the employers were denied a fair hearing in an unfair labor practice proceeding. The Examiner, whose findings and recommendations the Board adopted, assumed the role of prosecutor in securing a stipulation from one employer to complete the record and using it to institute a proceeding against another employer. He also rashly assailed the company officials for failure to obey the Board's subpoena. (NLRB vs. Phelps)

### * *Bargaining Agent May Be Redetermined*

Although a valid contract usually serves to prevent reopening of the question of the employees' proper bargaining agent, the fact that an employer had explicitly recognized a union as the majority representative does not prevent redetermination of the bargaining agent. (Henry Weis Manufacturing Company)

### * *Representation Rights of Instructors and Guards*

Instructors and guards are not to be barred from bargaining units. The former do not hire, discharge, or discipline other employees, and are not regarded by the rank and file of employees as representatives of management. The latter, although their reports may lead to discharge, do not represent management; discharge is not discretionary with them but is the result of facts reported. (United Wallpaper Factories, Inc.; Federal Motor Truck Co.)

### * *Employer Denied Injunction*

The Florida Supreme Court held that an employer is not entitled to an injunction restraining a union from imposing fines on its members because they used spray guns and not brushes when painting buildings at an Army air base.

The Court ruled that the regulation, being designed to protect the health and the employment opportunities of union members, involved internal affairs of no concern to the Courts. (Harper vs. Hoecherl)

### * *Representation Restriction Illegal*

NLRB ruled that a collective bargaining contract in which the union agrees not to represent a particular class of employees has no effect upon the right of that class of employees to choose the union or any other union to represent it. Such a limitation on the right of employees is illegal. (Tampa Shipbuilding Company, Inc.)

### *Penalty for Discriminatory Reinstatement*

NLRB awarded back pay to employees who, on being offered inferior jobs, declined to accept them. The offer of such inferior jobs constituted a constructive discharge. (Waples-Platter Company)

### *Not Discrimination*

An employer was not guilty of discrimination for discharging a large number of sit-down strikers where the discharges were based *solely* on their participation in the

EWING GALLOWAY

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One of the most important uses of *compressed air* is the operation of **air tools** used by our nation's war industries. These tools are in such universal use because they are light in weight, durable, safe, easy to handle, and packed with a power that is easily regulated . . . all features enabling workers to improve their skill and increase production.

Industrial production problems require an assortment of *compressed air* equipment. Ingersoll-Rand has available many sizes and types of **air tools** for your selection. We also offer a complete line of compressors to supply air for countless other uses.

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Ask your mill-supply dealer to show you a WELLS, No. 8, in actual operation — you'll like its performance.

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| Capacity: Rectangle | 8" x 16" |
| (Spec. bowed guides) | 5" x 24" |
| Rounds | 8" dia. |
| Speeds: ft. per min. | 60, 90, 130 |
| Motor | Specifications optional |

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Wells METAL CUTTING BAND SAWS

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strike and in the attendant violence and not on union membership or legitimate activity. (Mid-Continental Petroleum Corp.)

### *Held Coercion*

Though employers have the right to free speech the Board may consider anti-union remarks as evidence of interference with the rights guaranteed employees by the Wagner Act. Where the Board found that the employer, in addition to his anti-union words, also discriminatorily discharged union members and refused to recognize a majority union, management could not claim its constitutional prerogative. (NLRB vs. Pick Manufacturing Company)

### *Held Discrimination*

A company may not discriminate against the union under the guise of eliminating delays in production. The delays were found not to have been occasioned by the activities of the discharged employees. (Piedmont Shirt Company)

Transferring guards as employees to a sheriff (who was given complete control) appointed by the state in order to avoid unionization was held to be a discriminatory lockout. (Tampa Shipbuilding Company, Inc.)

### *Penalty for Domination*

The Supreme Court ordered an employer guilty of domination and having checked off dues to return the payments. The check-off having been compulsory and combined with a closed shop, the return of dues was held to be the price exacted for supporting an illegal organization. (NLRB vs. Virginia Electric & Power Company)

### *Penalty*

The U. S. Supreme Court's recent sanction of NLRB's power to require check off refunds has been put to use. In accordance with this power, NLRB ordered an employer to reimburse his employees for dues checked off for a union found to be company-dominated. (Donnelly Garment Company)

### * *Restrictive State Legislation*

Under the Pennsylvania Labor Relations Act as recently amended, certification of a labor union as a bargaining agent may now be challenged through the courts. To enjoy the privileges of the law, unions may not exclude persons form membership because of political affiliations.

The Minnesota State Labor Relations Act has added unfair labor practices forbidden to employees, i.e., striking in violation of a contract with which the employer is complying in good faith; participating in a strike not voted for by a majority of the employees; and interference with free and uninterrupted use of public roads.

Another Minnesota Act requires the election of union officers at least once every four years, and submission of final reports to members at least once a year under penalty of forfeiting the privilege of acting as bargaining agent.

# *Consistent Results in* WELDING

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This single adjustment is easy to make and requires only the simplest tools. Any operator can make it and thereby insure consistent welding results by keeping opening-time uniform.

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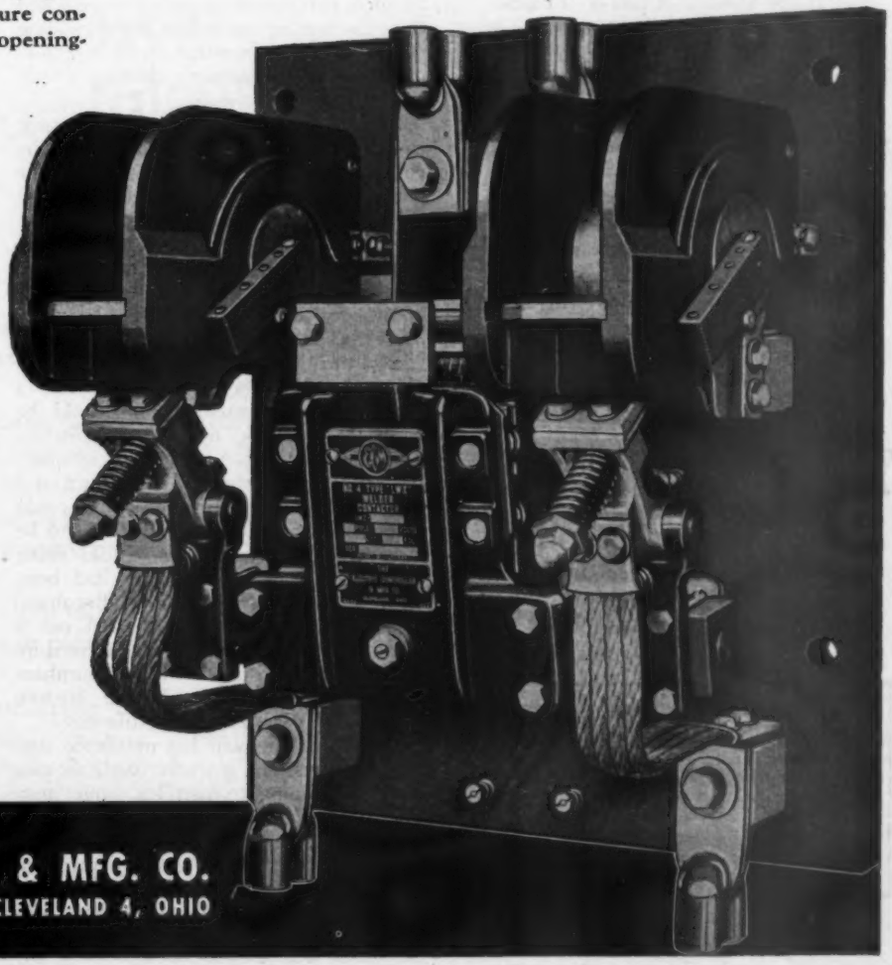
We build six standard sizes of welder contactors. At the right is the No. 4W size. Ratings are based on duty cycle curves as shown in Bulletin 1211.



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# THEY SAY AND DO

## Canadian Awards Plan for Workers' Suggestions

JAMES MONTAGNES, Canadian Correspondent

Canadian war workers who would not normally be expected to advance production-improvement ideas as part of their regular duties, are encouraged to submit ideas for speeding up production, simplifying operations, saving materials or skilled labor, and reducing plant safety hazards, under a standardized plan of the conservation of the Department of Munitions and Supply. Such workers are eligible for awards paid in Victory Bonds or War Savings Certificates up to $750, the awards being based on their percentage of time-saving value.

Typical of the awards paid out in recent months to Canadian workers is that of Joe Savigra, a worker at McKinnon Industries, Ltd., St. Catherines, Ont. An engineering redesign changed the oil seal of an army axle shaft from the "upset" end to the wheel end. Consequently the full length of the upset portion of the shaft was not being used in standard production.

Savigra submitted a suggestion which involved shortening the upset end. Plant supervisors liked the idea and developed it further. In the form it was finally adopted, two expensive tools were removed from the turning operations and a grinding operation was eliminated, with a consequent saving of expensive abrasive wheels and man-hours.

Savigra received the maximum possible award under the Suggestion Plan. The change involved other employees and the percentage of time-saving value was so high that it was possible to make further awards of $25 each to eleven employees of the gear division. Six employees of the forge division who helped work out application of the idea received smaller awards.

At the De Havilland Aircraft of Canada, Ltd., Toronto, production of the plywood Mosquito bomber required a patching cement mixture that could be used for building up cement fuselage jigs. The mixture had to have special qualities of a type that could be planed and sanded to required contours, that could hold nails driven into it, and it had to be a cement that would stick to lead lining in molds. After various types had been tried to no avail, a painter, R. C. Burnham, tackled the problem. He worked out a patching cement of his own. The mixture was tried out and approved, and Burnham received an award of $210 in Victory Bonds and War Savings Certificates.

The Canadian plan has numbered suggestion forms, and a worker with an idea and not wishing to sign his name, may send in his idea on one half the numbered form. At a weekly meeting the factory's suggestion plan committee, usually departmental superintendents, factory manager, and supervisors, considers all suggestions and pins up the suggestion slip numbers of those approved, together with the amount of the award. This eliminates a certain amount of "kidding" by employees, helps the suggestions to flow in. The winner takes his half of the suggestion slip to the plant office to receive his award. The plan gives the man on the job a chance to indicate how conservations in material and labor can be made. Employees whose work falls into the creative categories, such as engineering, processing, tool design, and production planning, and supervisors are not eligible for awards.

An idea of how the plan is going over can be had from results at the John Inglis Co., Ltd., armament plant, Toronto. In eight months, from September, 1942 to April, 1943, a total of 4200 suggestions were submitted and 460 were adopted. Workers' ideas at this factory are saving man-hours valued at $259,403; materials worth $86,827; and machine tools released for other work to a value of $285,702; a total saving of $631,952 on arms contracts at peak annual production.

•

## Factory Readers Know the Letter of the Law

*(The following comments on the Selective Service Act of 1940, and specifically on Section 8 of the Act, as amended in 1941, are quoted from a letter to the editor written by* FACTORY *reader, Agnes T. Hirshinger, New York. Remarks were stimulated by the article "Jobs After the War," July, 1943, issue of* FACTORY.*)*

"I have just finished looking over a copy of a reprint from FACTORY entitled 'Jobs After the War.' On the second page of this reprint under the heading 'What the Law Doesn't Say,' there is a question, 'Does the law apply to WAACS, WAVES, and the like?'

"Under this heading you state the law does definitely apply to all members of the armed services whether voluntary or inducted, and intimate that this interpretation is upon good authority although it is not derived from the law itself (The Selective Service Act).

"Inasmuch as I recently ran into this question (the apparent penalization of the volunteer who was not included in the benefits provided by Section 8 of the SSA), I would like to call your attention to the fact that the Service Extension Act of 1941 (Res August 18, 1941, C.362, 55 Stat. 626-628) reads as follows, under Section 357:

" '*Any person who, subsequent to May 1st, 1940, and prior to the termination of the authority conferred by Section 2 of this joint resolution, shall have entered upon active military or naval service in the land or naval forces of the United States shall be entitled to all the reemployment benefits of Section 8 of the Selective*

In a recent letter from a lad at Guadalcanal to his former employer was voiced the greatest challenge of our time.

"What," he said, "am I, and all these fellows with me, going to do when this thing is over?" Is peace to bring with it the deadly spiral: men laid off and demobilized, hence less purchasing power, hence more plants closed down, hence more men laid off, hence — ?

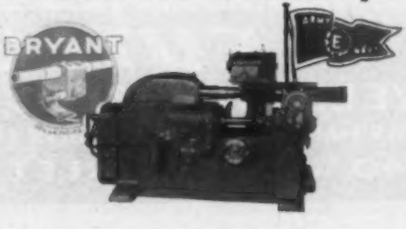
We believe we've seen the answer right on the production lines and right in the post-war plans of American industry.

We've seen and consulted with hundreds of research men uncovering new secrets in metallurgy, synthetics, plastics, aeronautics — finding new techniques and economies — planning new and wonderful products that will cushion the post-war interim to the greatest production age in history.

As internal grinding specialists, we at Bryant have already helped to solve production problems involving the machining of many new light metals, alloys, and synthetic materials including glass, plastics, hard rubber, wood, graphite, and even machine parts made of paper.

We've developed many new techniques in tooling, and we believe that this knowledge is important to your future. For that reason, our Consulting Service is available at all times. Call upon us now!

SEND FOR THE MAN FROM BRYANT . . .

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Springfield, Vermont, U. S. A.

Castolin Eutectic

LOW TEMPERATURE WELDING

SIMPLIFIED DESIGN

FASTER PRODUCTION

MADE POSSIBLE WITH

CASTOLIN EUTECTIC ALLOY No. 16 Patented

PROBLEM

Fabrication of this intricate steel aircraft tubular assembly with high temperature fusion welding was impractical because the high heat resulted in distortion and softening of the metal. Additional time required for machining the joints rendered the process too costly.

SOLUTION

Castolin Eutectic Alloy No. 16 eliminated the distortion and softening of the metal. How? This Low Temperature alloy binds at 1300° F. • Gives tensile strength of 117,000 lbs. per sq. in. • Three times faster than fusion welding • One third the cost of silver solder — three times the strength • Clean thin fillets eliminate after-machining.

*Castolin Eutectic Alloy No. 16 for use on all steels: chrome-moly, chrome nickel, high speed vanadium steel, iron and malleable iron. Also for joining these to other metals and for tool salvaging.*

Only "Eutectic* Alloys" are the true Low Temperature Welding Alloys that are revolutionizing production welding, maintenance welding and salvaging in war plants throughout the nation. There are 42 specialized rods for every metal and every welding job. Developed and manufactured only by Eutectic Welding Alloys Company.
*Reg. U. S. Pat. Off.

New 36 page Welding Data Book "J" Write Today

EUTECTIC WELDING ALLOYS COMPANY

SOLE MANUFACTURER – CASTOLIN EUTECTIC WELDING ALLOYS

40 WORTH STREET, NEW YORK, N.Y


*Training Act of 1940* to the same extent as in the case of persons inducted under said Act: Provided, That the provisions of Section 8 (b) (A) of said Act shall be applicable to any such person without regard to whether the position which he held shall have been covered into the classified civil service during the period of his military or naval service.'

"This would definitely remove the matter from any possible doubtful status. Many people are not aware of this statute you might wish to supplement your reprint."

### Disabled Veterans

*(Frank T. Hines, Administrator, Veterans Administration, Washington, D. C., gives additional information on Public Law 16 discussed under the heading "Plans for Disabled Veterans" in "Jobs After the War.")*

"I . . . shall confine my comment to the section captioned "Plans for Disabled Veterans," which . . . is concerned particularly with the reemployment of veterans.

"It is anticipated that the vocational rehabilitation of honorably discharged veterans having a pensionable disability which produces a vocational handicap will be predicated upon the veteran's educational level, acquired vocational experience, and personal desires, and will consist of institutional training or job training or such combination of both as may be necessary to restore employability lost by virtue of a handicap due to a service-incurred or aggravated disability. Paragraph numbered 2 of Part VII of Public Law No. 16, 78th Congress, is as follows:

" 'The Administrator shall have the power and duty to prescribe and provide suitable training to persons included in paragraph I, and for such purposes may employ such additional personnel and experts as are deemed necessary, and may utilize and extend existing Veterans' Administration facilities and utilize those of any other governmental agency as well as those maintained by joint Federal and State contribution; and, in addition, he may, by agreement or contract with public or private institutions or establishments, provide for such additional training facilities as may be suitable and necessary to accomplish the purposes of this part.'

"You will note that the power and duty to prescribe suitable training is the responsibility of the Administrator. Cooperation with 'state rehabilitation and vocational training services' will be maintained but no part of the responsibilities of this office will be delegated to such agencies."

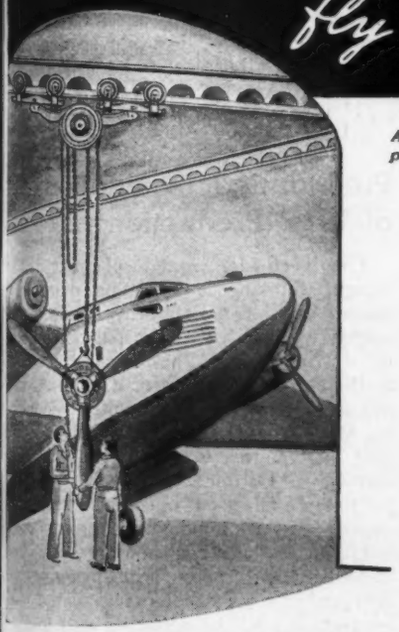
•

## Pool Experiences on Uses for Metal Stampings

To cooperate closely with appropriate government departments to speed up and increase mass production of war materials, and to engage in research to develop new and extended uses for metal stampings in the post-war period, some 60 representatives of sheet and strip metal fabricators, rolling mills, and metal press manufacturers

# SERVICING the WINGS that fly the GLOBE

*These are the routes of the Pan American World Airways System previous to December 7, 1941.



*Cleveland Tramrail equipment helps Pan American service planes easier and faster at air bases in far flung parts of the world.*

★

The Pan American Airways System in collaboration with the Air Transport Command has built air bases at strategic places in far flung parts of the world.

These bases have been equipped to service, as quickly as possible, giant Pan American Clippers, Army Bombers and other aircraft after long hops across the six continents and over vast stretches of ocean.

It was evident to Pan American engineers that much valuable time in servicing the aircraft could be saved by the use of overhead materials handling equipment. A thorough study of the various equipment convinced them that the design and quality of Cleveland Tramrail would best assure smooth trouble-free operation so necessary for their remote bases.

Cleveland Tramrail knowing full well the urgent need of the equipment has cooperated wholeheartedly with Pan American. The equipment for the first base was made in record time and aboard ship before the departure deadline. Other equipment has since been built posthaste.

Thus Cleveland Tramrail is not only a major factor in the construction of planes in many plants on the home front, but is also aiding in keeping them flying to and from our many scattered war fronts.

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BOOKLET No. 2008. Packed with valuable information. Profusely illustrated. Write for free copy.

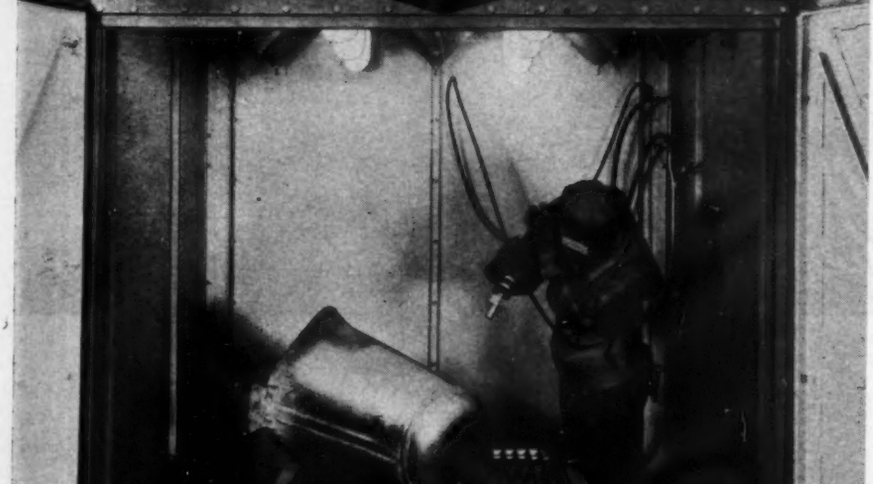
**CLEVELAND TRAMRAIL DIVISION**
THE CLEVELAND CRANE & ENGINEERING CO.
1187 EAST 285TH ST. WICKLIFFE, OHIO.

**CLEVELAND TRAMRAIL**
OVERHEAD MATERIALS HANDLING EQUIPMENT

Parsons

SAND-BLAST ROOMS

FOR INCREASED PRODUCTION



Parsons Sand Blast rooms are engineered from top to bottom, inside and out. Modern in every respect . . . . construction, operation and performance. Better ventilation, better lighting with everything at the operator's fingertips.

Par-Blast rooms are furnished in a number of designs, depending on the work or pieces to be cleaned. The Turntable, Car, Monorail and small cabinet types are all outstanding in their particular field and have gained world wide recognition on performance and economy.

You will find Parsons creative engineering in all types which means faster and more thorough cleaning, simplified and easier operation at lower operating costs. Send for free bulletin or better yet let us have your blast cleaning problems. We will be glad to suggest equipment best adapted to your specific work.

PARSONS

ENGINEERING CORP.

2545 EAST 79th STREET • CLEVELAND, OHIO


recently organized the Pressed Metal Institute, with headquarters in New York.

A recent report from the office of the Chief of Ordnance, U. S. Army, shows that the Ordnance conversion program, which includes extensive shifts to pressed metal techniques, is saving large quantities of aluminum, copper, steel, nickel, chromium, tin, molybdenum, and other materials. The program is providing relief for overburdened machines and helping to stretch the United States stockpiles of critical metals.

Commenting on this report, George R. Whitlock, president, Mullins Mfg. Corporation, Warren, Ohio, and president of the newly formed Institute, stated, "These results are encouraging but leaders in the industry are convinced that only by united effort, exchange of data, and pooling of experience can maximum results be obtained and, therefore, the Pressed Metal Institute was organized. It is believed that through this association, the industry will accomplish much more than individual concerns working alone could possibly achieve."

S. J. Menzel, Motors Metal Mfg. Company, Detroit, is vice-president of the Institute, and H. L. Moody, Stevenson, Jordan & Harrison, New York, is secretary-treasurer and managing director. Over-all management of the Institute is to be in the hands of a board of trustees.

•

## Pre-Planned Liquidation of War Production Asked

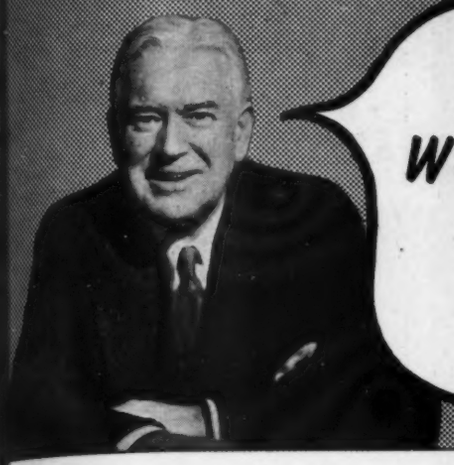
The need for sound planning and straight thinking is becoming more apparent as the nation strives toward a mighty war goal. It is the duty of industry to make itself heard constructively in these critical times according to Alvan Macauley, president, Automotive Council for War Production, in an address delivered before the Council at its annual meeting in Detroit.

"Because all of our operations are predicated on a war of indeterminate duration, we should feel justified now in calling for immediate and thorough pre-planning by government for the liquidation of the war production job," he declared.

"That is not a job that can be done when the end of the war is in sight. The history of World War I is unmistakable on that point. While then only a small part of the national economy was involved, the disposition of war contracts was a painfully slow process, so insufficiently conceived and planned that it left a trail of turmoil and difficulties stretching over years.

"Unless something far different, far more responsive to needs than has so far been put into operation, is developed for the orderly liquidation of the present total war production job, there can be no blinking the fact that the consequences will be ruinous.

"It must not be forgotten that only production makes jobs, creates purchasing power, maintains standards of living and invigorates a nation. There will be tens of millions seeking jobs at the end of the

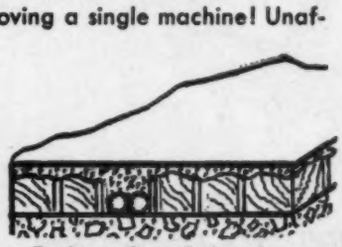


# WE'VE INCREASED OUR WORKERS' EFFICIENCY WITH WARM-QUIET-RESTFUL PERMAFLEX FLOORS!

Production is speeded . . . workers' efficiency maintained by Permaflex floors. Greater comfort and quietness is obtained at the same time increasing floor resistance to wear! Permaflex is a rubbery textured mineral and chemical compound that is used as an admixture with the aggregates used in concrete. It can be easily and quickly installed right over your present flooring, without moving a single machine! Unaffected by atmospheric conditions . . . suitable for interior or exterior application. Can be applied over concrete, wood, metal, brick or stone floors. Scores of the nation's leading industrial plants are now using Permaflex floor installations.

RESURFACING WOOD

RESURFACING CONCRETE



Relay Conduits in Wood block floor

## Will Not Rut under 3000 lbs. per Square Inch!

Permaflex shows less than 1/32 inch indentation under loads of 3000 lbs. per square inch! That's hard . . . that's wear-proof! No other flooring offers this amazing resistance and at the same time provides the resiliency and warmth necessary for employee comfort!

## SPECIAL TRIAL OFFER

We want you to test Permaflex in your own plant . . . under your own operating conditions. We will ship you 5 gallons of Permaflex . . . enough to install 90 square feet of ¼" thick heavy-duty floor . . . f.o.b. Philadelphia. Install it, according to directions, in your plant where it will be under the most severe conditions you have. If after 45 days, you find that Permaflex answers your problems, pay us the regular price for the shipment. If it does not perform as you think it should, you are not obligated in any way! You be the judge!

- Warmer! Quieter! All Day Comfort!
- Resilient . . . Easy on the Feet!
- Insulates against Dampness, Cold and Sound!
- Dropped Tools Will Not Chip!
- Dustproof! No dust originates from Permaflex!
- Slipproof! Waterproof! Wearproof!
- Applies right over Old or New Floors!
- Can lay Conduits in wood block floors without tearing out concrete base.
- Bonds perfectly . . . Finishes to a Feather Edge!
- Can be Installed Paper-Thin or Inches Thick!
- Ready for Use in 24 to 36 Hours!
- Black Color . . . Can be Painted any Color!
- Not to be used where Oil, Acid or Continuous wet conditions exist.

# PERMAFLEX

PERMAFLEX PRODUCTS CO.
1844 N. FRONT ST., PHILA., PA.

INSTALL COMPLETE 12½c per sq. ft.

war, and only production will make the employment possible. Only their employment will pay taxes and sustain services and communities.

"Production will not be possible so long as plants are tied up pending deliberate consideration of what this or that government agency wants done with machines it owns; pending survey and disposition of huge quantities of materials in various stages of manufacture occupying factory floors; or pending release of funds, which in most cases will represent all and more of the working capital of tens of thousands of manufacturing establishments.

"It must not be forgotten," he continued, "that the typical war contracting company, pressed by the government and the national necessity, has been handling and will continue to handle a volume of business that it would not dare undertake on its means under any other circumstances. In peacetime, a business concern will not extend its sales to the point that delay in payment by its customers will prevent meeting its payroll and other obligations. In wartime every company has done so and must do so for the one customer we have.

"During wartime the government fully recognizes the necessity of prompt payment and of advances to meet the enormous daily costs. But the government is not set up today to close out such a volume of business with any comparable speed. On the contrary, existing regulations, practices, and laws require procedures making rapid settlement impossible.

"This is a type of planning that, at this stage of the war program, can be developed and completed without affecting as much as an hour's output. Its completion in advance will make for a better job of carrying on the war for as long as may be required."

•

## Some Facts and Figures on Absenteeism

Not satisfied with a rough estimate of the rate of absenteeism in their city, a group of Milwaukee citizens, with Father Raphael C. McCarthy, president of Marquette University, as leader, formed an organization to investigate the extent and causes of absenteeism in Milwaukee, and if possible, apply suitable remedies. Known as the Committee on Industrial Absenteeism, the group recently made a report on the result of the first two surveys of absenteeism, defining the word absence as "failure (for any reason) of a worker to report on the job at a time when he or she is scheduled to work."

Conducted by the Bureau of Economic and Business Research, Marquette University, the first survey covered the first quarter of the year 1943. Invitations to cooperate in this survey were sent to 173 firms engaged in war production in Milwaukee. Data were obtained from a total of 64 firms. The companies were divided into four groups: (1) Those submitting data weekly for a 13-week period; (2) those submitting data weekly for less than 13 weeks; (3) those reporting actual total

# 0.1 ounce BLOCK BUSTER . . .
## Axis "Secret" Weapon

**A Cigarette** thrown carelessly in a packed warehouse can be as destructive as a 2 ton Block Buster. Not only may it prove a calamity to a business enterprise but, far more important, it may destroy war materiel desperately needed by our fighting forces . . . a double calamity made more tragic because most fires such as this can be prevented. Yet the fire loss in buildings and materials alone in the U. S. was over $300,000,000 last year.

**Fire CAN Be Controlled!** Experts say the one sure way to prevent fires from getting out of hand is control *at the source, at the start . . .* with automatic sprinklers. Dependable Grinnell Sprinkler Systems detect and check fires *automatically,* night or day, before major damage can occur.

**Protection for So Little!** One Grinnell Sprinkler Head protects 100 square feet of building space. Installed, it needs only about 50 pounds of pipe, fittings and valves . . . yet it can save tons of structural steel and other critical materials. This comparatively small expenditure of materials can provide the 24-hour-a-day protection against fire . . . against interruption of war production and loss of vital materials, today. See Grinnell *before fire strikes!*

*Grinnell Company stands ready to protect your warehouse or plant against fire. Experienced engineers at nearby offices are ready to help you. Call them. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.*

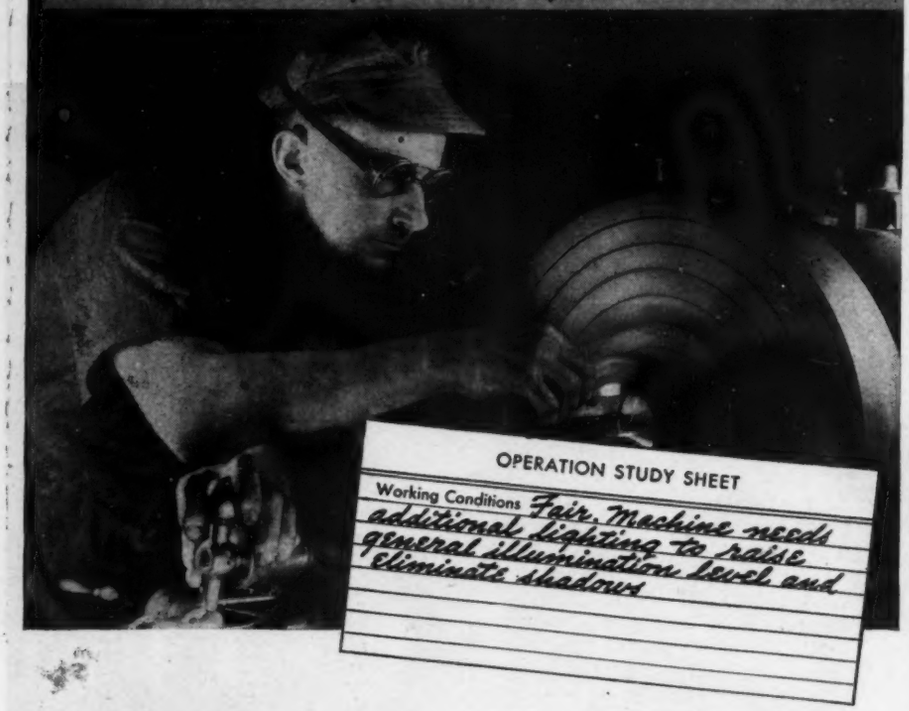
**GRINNELL**

**AUTOMATIC SPRINKLERS**

***For Production Protection***

RE-LIGHTING

*the new* manpower / production *requirement*


OPERATION STUDY SHEET
Working Conditions Fair. Machine needs additional lighting to raise general illumination level and eliminate shadows

# *This man needs more light*

The plant where this worker is employed—like most plants built before Pearl Harbor—was probably designed for peacetime production, with lighting equipment intended merely to supplement daylight. Hence, *its lighting system is inadequate for wartime night work*—and production falls off seriously on the "swing shifts."

*Re-lighting* for better illumination will correct this condition, make it easier for workers to see—thus increasing efficiency and production. Re-lighting costs little and is easy to arrange. A Silv-A-King lighting engineer, for instance, can tell you quickly how to re-locate lamps to eliminate glare and shadow...show you where it is necessary to increase lamp wattages or install additional equipment to insure uniform high lighting levels.

*Silv-A-King fluorescent equipment, with reflectors of non-critical Silv-A-Tex, is available for prompt delivery to war plants.* Silv-A-King equipment (fluorescent or incandescent), plus a Silv-A-King "engineered layout" make an unbeatable combination.

**BRIGHT LIGHT REFLECTOR COMPANY, INC.**
*1027 Metropolitan Avenue, Brooklyn 2, N. Y.*

*Send for new Folder 43-V describing Silv-A-King "Victory" Fluorescent Units.*

FLUORESCENT
SILV-A-KING
INCANDESCENT

**SILV-A-KING MAKES *Light* WORK FOR YOU**


figures for the period; (4) those reporting estimated total figures for the period. A summary covering all groups showed that in 64 companies, 67,312 workers scheduled to work 5,037,694 days had lost 22[illegible] 494 days due to absences. The composite average was an absenteeism rate of 4.4[illegible] percent, with the average number of days lost per worker during the first quarter coming to 3.35 days.

In a summary of averages according to size of plant, rates were: Less than 10[illegible] employees—4.43 percent; 100 to 200 employees—200 to 500 employees—5.11 percent; 500 to 1000 employees—5.09 percent; over 1000 employees—4.28 percent. The lowest average for any company reporting was 0.57 percent. The highest average was 12.88 percent.

## Second Survey

The second survey was conducted for the week of May 10-15 to obtain information from reporting companies on the over-all rate of absences for the week beginning May 10, and the percentages of total absences due to five specific categories of causes: Sickness, injury, absence with permission, absence due to unknown causes, and absence due to all other causes. The survey included only employees paid on a wage-rate basis.

The over-all rate of absences for the 47,652 factory workers employed by the 41 companies reporting for the May period was 4.97 percent. Of the total of 14,109.7 man-days lost due to absences, 45.39 percent were due to sickness; 3.84 percent to injury; 18.13 percent to absences with permission; 23.53 percent to unknown causes and 9.11 percent to all other causes. (There was some variation in the manner of reporting "unknown causes" and "all other causes." Combined percentage of the two was 32.64 percent.)

Relative to total man-days scheduled, the percentage of absences due to the five categories of causes was sickness, 2.26 percent; injury, 0.19 percent; with permission, 0.90 percent; unknown causes, 1.13 percent; all other causes, 0.45 percent; total, 4.97 percent.

In comparing absence rates of female employees with that of male employees, the rate for 6627 women was 7.04 percent against 2.98 percent for men. The most prevalent cause for absence in both groups was sickness.

In considering the average rate of absence by days of the week, percentages were: Monday, 20.41; Tuesday, 15.61; Wednesday, 15.64; Thursday, 16.88; Friday, 15.20; Saturday, 16.26.

Evidence regarding the common belief that the percentage of absenteeism rises on the day after pay day is inconclusive from this survey. Of the 26 companies reporting pay days within the week of May 10-15, thirteen companies, employing 25,780 men and women, showed increases on the day after pay day, the average rate of increase being 2.88 percent. On the other hand, thirteen companies, with a total of 10,910 employees showed decreases. The average rate of decrease was 1.04 percent.

Interviews with about twenty of the reporting companies were conducted by

# WIN A WAR BOND . . . tell why

# dag COLLOIDAL GRAPHITE

REG. U.S. PAT. OFF.

**IS IMPORTANT in the Manufacture or Use of Each of the 4 Items Illustrated**

## *How "dag" Colloidal Graphite is Used for Impregnation and Surface Coatings

At the right you find out how to win a War Bond. Here you find how **dag** colloidal graphite is used by industry for purposes other than those illustrated above.

Asbestos packing, clutch facings and brake linings are impregnated with **dag** colloidal graphite to provide the lubrication which increases both their effectiveness and their service life.

Abrasive wheels are impregnated to reduce frictional heat of operation and to make them electrically conductive elements for use in electrical grinding control circuits.

Paper is impregnated to give it electrical conductivity, to reduce its translucence, or to color it.

Electrical insulation (final layers) is impregnated to reduce corona on windings of electrical machines.

The fabric in laminated plastics used in bearings, bushings, etc. when impregnated produces less frictional resistance and has a much longer service life.

Impregnating textiles, ropes and cables reduces interfiber friction and gives the materials greater resistance to wear.

Porous bearing metals impregnated have a lower coefficient of friction and maximum service life.

Coating drive belting with colloidal graphite makes it possible to bleed-off static charges of electricity.

*A TYPICAL APPLICATION

***Write*** **for free bulletin No. 431, HH "dag Colloidal Graphite for Impregnation and Surface Coatings."**

## How to Win

Acheson Colloids Corporation will give a $25.00 War Bond to each of the 5 people who submit complete and accurate answers together with the 5 best letters on the question, "Why is **dag** colloidal graphite important in the manufacture and/or use of each of the products pictured here?" (1) State business connections (no one in the graphite field or their families is eligible). (2) All entries must be legible. (3) All entries must state the publication in which the advertisement was seen. (4) Entries must be postmarked not later than September 15, 1943. (5) In case of ties, duplicate awards will be made. (6) Entries become the property of the Acheson Colloids Corp. (7) The verdict of the judges will be final.

**These are two of the War Bond winners. Others will be introduced in subsequent issues.**

**Mr. C. J. Krister, member of the research staff of E. I. du Pont de Nemours & Co., Inc., Grasselli Chemicals Dept., Wilmington, Delaware.**

**Mr. J. William Glenn, Chief Chemist, General Chemical Company, Buffalo Works, Buffalo, New York.**

dag COLLOIDAL PRODUCTS

**ACHESON COLLOIDS CORPORATION**

**PORT HURON MICHIGAN**

# CONTROLLED throughout . .

"MONARCH" Lathe
. . . Bijur-Equipped.

The correct oil film to each individual bearing... automatically

■ **LUBRICATION CONTROL is of utmost importance in maintaining maximum output. Control must be positive—at all times. With a Bijur lubricator on the job, manpower is concentrated on actual production. The machine practically takes care of itself over long periods of operation.**

**BIJUR LUBRICATING CORPORATION**
**Long Island City New York**

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**BIJUR**
AUTOMATIC *Metered* LUBRICATION


telephone to obtain information on the nature of the causes of absences listed under "absence with permission" and "absences due to all other causes." The opinion was general among employers that regular employees (four years or longer) did not create an absentee problem, that practically all the preventable absenteeism, particularly in factories with high absentee rates, was caused by the "drifters" and by those coming into the city from outside areas.

The chief causes for which permission for absence was granted appeared to be:

1. Illness in the home when the employee was needed to attend to sick and home duties.
2. Marriages or funerals of relatives.
3. Visits to doctors, dentists, to have glasses fitted, and similar medical attention; not necessarily illness.
4. Trips by young wives to visit husbands in the service; or time off to be with husband or fiance when he is home on furlough.
5. Appearances in court (reasons for court appearances hard to get from employees).
6. Appearances before draft board.
7. Young people required to attend vocational school.
8. Attendance at conventions or organization meetings.

### Week-End Spree

The cause reported most often under "absences due to all other causes" was the "week-end spree." This was considered to be one of the most important causes of the high rate of absenteeism prevailing on Monday. The opinion prevailed that large sums paid to workers caused them to seek an outlet for spending surplus money. This statement, however, was confined for the most part to drifters and new workers. The old, regular employees saved their money. In plants employing Negroes, this cause of absenteeism was especially emphasized. Even among the plants employing principally women, the mention of the "week-end spree" was not uncommon.

Other causes mentioned under this heading were:

1. Out of town, on vacation. Failed to return at appointed time. This was also considered to have a bearing on the high Monday rate.
2. Shopping. This cause was not mentioned often. Many employers stated they would not know if it did occur as it would not be likely to be reported.
3. Job-shopping. This was not considered important by many employers.
4. Stoppage because of breakdown of machinery. This was mentioned by only a few companies.

•

## Teaches New Technique for Splicing Cotton Belts

A school to teach men from other industries the secrets of a cotton belt splicing technique that has saved thousands of dollars' worth of time and materials in

# P&H HEVI-LIFT HOISTS

ARMY-NAVY "E"

*A new star has been added to P&H's award for excellence in war production.*

*"Ready? Hoist! We'll show 'em a thing or two about production. And hang up some records they can't forget."*

But for war, they might never see the inside of an industrial plant. But here they are—thousands of older men and women—giving their best to overcome lack of experience—to keep faith with our fighting forces—to make sure that vital supplies are neither too little nor too late.

As these new workers take the places of experienced men, more and more Hevi-Lift Hoists are joining them to facilitate the handling of heavy loads on and off machine tools, along assembly lines, in shipping departments and loading zones—wherever fast handling can lessen labor, save time, and speed the war effort.

## P&H HEVI-LIFT HOISTS

*Built in capacities up to 15 tons. Five-step variable speed push-button control is available for lifting, lowering or horizontal trolley travel. Write for literature.*

*General Offices:* 4525 W. National Ave., Milwaukee, Wis.

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HOISTS • WELDING ELECTRODES • MOTORS P&H EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

# PROTECTION—1943 STYLE

Designers of war equipment learned a lot from World War I. From the standpoint of protection, there is no comparison between the modern helmet of today and what the doughboys wore in '17.

Packing design, too, has taken great strides in meeting the new requirements of World War II.

The General All-Bound, for instance, is giving maximum safety to a wide range of vital supplies. Made of selected woods, this engineered box is wire stitched and bound. Consequently, it provides the strength of steel on all six surfaces. Assembly is quick and easy . . . as it comes in one piece. No nails are required. The sure, firm closure gives maximum safety. The Rock Fasteners (loop closures) are opened quickly and easily when the shipment reaches destination. No vital minutes are lost.

Why not see if General Boxes can give your war shipments the extra safety and speed that wartime requirements demand? General Box engineers have solved countless shipping problems for manufacturers in many industries. Their extensive war experience has equipped them to help you meet your government packing specifications. Write today.

*For manufacturers of war products:* ***General Heavy Duty Wire-Bound and Nailed Wooden BOXES and CRATES***

*Where availability of materials permits:* ***Corrugated BOXES and Wood Cleated Fibreboard CONTAINERS, Generalite and Nailed Strapped BEVERAGE CASES for Domestic Service***

**GENERAL BOX COMPANY**

***GENERAL OFFICES:*** **504 N. Dearborn Street, Chicago, Ill.**
***DISTRICT OFFICES AND PLANTS:*** **Brooklyn, Cincinnati, Detroit, East St. Louis, Kansas City, Louisville, Milwaukee, New Orleans, Sheboygan, Winchendon; Continental Box Company, Inc.: Houston, Dallas**


the construction of war equipment has been opened by Westinghouse Electric & Manufacturing Company, Pittsburgh.

According to Westinghouse officials, the use of this technique has increased the efficiency of machinery and released war-scarce leather and rubber for other uses. It also resulted in a savings of $12,000 during the first year of its operation. Patented, the method is being offered without charge to other companies for the war's duration.

Until a 60-year-old Westinghouse employee hit on an idea of cutting and cementing cotton web belting, there was no practical method of cutting and splicing cotton belts used on many machines. The belts had to be ordered to fit each machine or cut and sewed to size, an unsatisfactory method.

To get the new method across to as many shop men as possible, Westinghouse is planning to set up schools in its plants from coast to coast.

•

## Following Directions Can Be Easy


**EMERSON P. SCHMIDT, Economist & Secretary, Committee on Economic Policy, U. S. Chamber of Commerce, Washington**


Upgrading, in-training, and acceleration in the educational process have become bywords in these emergency days. In order to get on with the training job, we must do some things which in more leisurely times we would not have considered good educational practice.

In reading the interesting experiences of Louise Dickinson Rich in her book "We Took to the Woods" (J. B. Lippincott Co., Philadelphia), I ran across the following bit of homely advice on the learning process:

"I think the difficulty with people who can't follow printed directions for knitting or anything else is that they try to understand them. They read the whole thing through and it doesn't make sense to them, so they start with a defeatist attitude. They try to relate the first few steps to the whole, and there is no obvious relation, so they get discouraged and say, 'Oh, I can't learn things out of books. But if you'll just show me—'

"You don't have to understand directions. All you have to do is follow them; and you can follow them only one step at a time. What you need is not intelligence, but a blind faith. I never read directions through. I never read beyond the operation I am engaged in, having a simple trust that the person who wrote them knew what he was doing. That trust is usually justified. Oh, there's no trick to following directions, and if I don't teach Sally and Rufus one other thing, I'm going to teach them that. I think it's important."

Thousands of new, untrained teachers, both in and out of industry, are running into difficulties in trying to get the learner to understand directions. The foregoing quotation should give the beginner in the teaching profession a bit of sound advice.

Perhaps even for more leisurely teaching in the post-war, this quotation contains something worth while. Most teachers,

# RIGIDITY

## Keeps Century Motors a-runnin' under heavy shocks and vibrating loads

Century MOTORS

***Five features of Century design combine to assure freedom from distortion — freedom from noise — perfect alignment.***

1 The feet are cast as part of the motor frame with machined mounting surfaces providing for a firm attachment and alignment, essential when the motor is incorporated as part of precision equipment.

2 Rigid curved end-brackets are braced for permanent alignment of bearings to maintain a concentric magnetic field, essential to uniform characteristics and quiet operation.

3 Heavily ribbed cast iron frame holds the stator laminations in place — they are locked under pressure — they cannot shift position — the air gap is maintained.

4 A machined bead with close tolerance on the end-bracket fits inside a similarly machined surface on the motor frame — this accurately and permanently aligns the bearings in relation to each other and to the motor frame.

5 The rigid steel shaft is larger in diameter through the rotor which prevents deflection — protects against bearing wear.

Thus, when a Century Motor is bolted to a machine or foundation, you can expect uniform and quiet operating characteristics to be maintained for continuous service, 3-shift operation.

Your Century Application and Service Engineer will gladly tell you all of the advantages of Century Motors — help you select the *correct* Century Motor for practically any application, from fractional to 400 horsepower.

**CENTURY ELECTRIC CO.**

1806 Pine Street St. Louis, Missouri

***Offices and Stock Points in Principal Cities***

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***One of the Largest EXCLUSIVE Motor and Generator Manufacturers in the World***

Winning the "*Battle of Production*" involves a lot more than a supremacy of materials, machinery and manpower. One major fire . . . or a small fire that results in crippling damage by the extinguishing medium . . . can halt or slow down war production in a dozen vital plants.

Cardox Fire Extinguishing Systems are guarding against these crippling fires in plants producing a wide variety of critical war products. For example, individually engineered applications are on duty in important plants producing such military necessities as:

**Airplanes, Aviation Engines, Aviation Carburetors, Airplane Parts, Engine Parts, Plastics, Rubber Products, Processed Fabric, Tanks, Tank Engines, Cold Strip Steel, Armor Plate, Forgings, Solvents, Motor Fuel, Electric Power.**

By instant smothering of fire and cooling of combustibles through the mass discharge...at high rate of flow . . . of low pressure, low temperature $CO_2$, Cardox Systems provide the all-important advantage of fast, complete extinguishment of large or small fires—without damage by the extinguishing medium.

Today, Cardox is concentrating its engineering and manufacturing facilities on two basic activities: (1) Designing and manufacturing of Cardox Fire Extinguishing Systems needed to make it possible for the Armed Forces of America to have more planes, guns, tanks and ammunition; (2) working with industry on plans to increase the efficiency of fire protection both today and after the war.

If you would like more information, write on company letterhead for Bulletin 1183.

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CENTRAL STORAGE UNIT
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however, would agree that generally the student should, in time, understand the directions and the reasons therefore. But many teachers fully conversant with all details of a particular job or process, frequently are inclined to under-estimate the difficulties of rapid learning. The advice of Mrs. Rich should make the task easier for both the student and the teacher.

•

## Domestic Bookings of Trucks and Tractors

Domestic bookings of electric industrial trucks and tractors during the month of May, 1943, totaled 294 units, according to figures released by the Industrial Truck Statistical Association.

The net value of chasses only booked during May totaled $1,355,633.25 compared with $1,154,834 in April.

The May bookings included three non-elevating platform trucks with capacities and chasses base prices ranging from 3000 to 6000 pounds and $1450 to $2095, respectively, and a total net value of $5520; 225 cantilever trucks with capacities and chasses base prices ranging from 2000 to 20,000 and $2200 to $8950, respectively, and a total net value of $1,072,320.25; 22 light- and heavy-duty tractors with chasses base prices ranging from $1650 to $1755 had a total net value of $37,460; 18 crane trucks with capacities and chasses base prices ranging from 3000 pounds at 7 feet to 10,000 pounds at 5½ feet and $5480 to $8150, respectively, had a total net value of $119,640; and 26 special trucks with capacities of 2000 on boom and chasses base prices ranging from $4623.72 to $5100 had a total net chasses value of $120,693.

All net values are at factories after additions and deductions for variation from standard specifications, trade-in allowances, and such when applicable.

No adjustment has been made for cancellation of the following 1943 bookings: Two low lift trucks, value $4720; two fork trucks, value $7000; one crane truck, value $8150.

•

## WPB Taps Source of Idle Welding Equipment

The national reserve pool of used idle resistance welding equipment must be tapped first to meet demands before new equipment can be purchased. A new order recently issued by the War Production Board (L298) sets up procedure for establishing the pool by requiring owners of used idle equipment to register it with WPB.

Equipment is considered "idle" when it has not been used for welding operations more than 120 hours during a period of 90 consecutive days. Such equipment is registered on Form WPB-2732.

The order also does the following:

1. Requires manufacturers of resistance welding equipment on or before the fifteenth of each month to report on Form WPB-2830 all purchase orders for new

# SNAP-ON TOOLS HELP ROLL OUT THE TANKS!

Down the assembly lines roll the great M4 tanks . . . 30 tons of grim and deadly destructive power headed for the Axis . . . 30-ton mechanical monsters, mass-produced by the most advanced methods known to industry.

On M4 assembly lines *Snap-ons* are on the job . . . helping speed hand-tool operations on many critical assemblies . . . meeting every requirement for flexibility, precision, power.

In tank arsenals as in every important aviation plant . . . in vast shipyards and in victory geared industry throughout America, Snap-on tools are playing an important part. The 3,000 tools in the Snap-on line are distributed direct to users through 35 factory branches located in key production centers throughout the United States and Canada. Write for catalog and address of the nearest branch.

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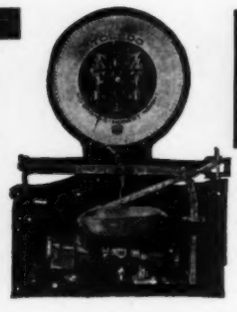
COUNT 'EM BY THE THOUSANDS *Like Lightning!*

*At airplane plants, thousands of parts for huge bombers are checked in daily at receiving docks, or issued from stock, with Toledo Counting Scales!*

● **Gear up production, increase accuracy and save labor... by *counting thousands of small parts in a few seconds* with Toledo Scales!**

**Easy for "green help" to operate. Whether it's issuing predetermined quantities of uniform parts... counting unknown quantities... faster inventory counts... or to get accurate receiving, shipping, production, cost and piece-work counts — COUNT BY WEIGHT the faster, better Toledo Way! Write for booklet "Counting by Weight". Sales and Service in 181 cities. Toledo Scale Company, Toledo, O.**



TOLEDO
COUNTING SCALES


and rebuilt resistance welding equipment and repair parts unfilled, received, and cancelled during the preceding month.

2. Prohibits a manufacturer or dealer from accepting orders for delivery of any new resistance welding equipment unless the order or delivery is specifically authorized on Form WPB-2752. This requirement, however, does not apply to purchase orders of $200 or less; to orders for resistance welding electrodes; to orders for resistance welding equipment for direct use by the Army, Navy, Maritime Commission, or War Shipping Administration; to any orders bearing preference ratings assigned under Preference Rating Order P-19-h; or to any orders placed by manufacturers of or dealers in resistance welding equipment.

Applications for authorization to purchase new equipment will be analyzed by WPB for the purpose of discovering whether or not the need of the purchaser can be supplied from the pool of used equipment. If it can, authorization to purchase new equipment will be withheld.

By substituting used for new equipment, officials of the General Industrial Equipment Division estimate a possible saving of 160 tons of copper products and 400 tons of steel products per quarter, and a significant saving of manpower.

There is no provision in the order requiring owners to sell their used idle resistance welding equipment.

•

## Canadian Women in Wartime Industry

Canadian women, eager to do their bit, have succeeded in mobilizing their forces into a valuable working army which has helped to make Canada the fourth largest producer of war supplies among the United Nations. By June 1, 1943, it was estimated there were 255,000 women engaged directly or indirectly in Canadian war work.

In appealing to women to take up war work of various kinds, Canada has used a partial registration, and has done considerable advertising of war industry and the women's armed services.

Last September National Selective Service conducted a registration of Canadian women from 20 to 24 years of age who had not been registered as employed through the Unemployment Insurance Commission. The registration was compulsory, and 258,583 women registered. Of these, 58,635 were willing to do full-time essential work, and about 23,000 indicated they would be available to undertake part-time war work. The women are under no compulsion to accept employment.

It was found that the registration, bringing a greater realization of the seriousness of the manpower situation, provided incentive to many women, even to those outside the age group registered, and thousands took up war work or joined the women's armed services. Employment and selective service offices were able to make good use of the information obtained in the registration.

Since the September registration, the

Secret War Plant

# LUBRICATES 1800 MACHINES In Seconds Each!

## Alemite Lubrikart is the Answer!

● This war plant is a military secret. It turns out high precision war material, using many types of machines including grinders, lathes, turret lathes, punch presses, steam hammers, automatic screw machines, etc., where perfect lubrication is an absolute *must*. Alemite Lubrikarts solved a tricky lubrication problem.

Model 2422-C

## How the Lubrikart Works

● The Alemite Lubrikart is a complete, compact portable power lubrication station on wheels. It has its own air compressor—or connects to house air lines. One stop lubricates high pressure fittings, fills gear housings, services oil cups accurately, dependably with metered delivery. It's easy to train oilers to *know* that every machine is getting correct lubrication regularly.

## Here's the Inside Story of How ALEMITE LUBRIKARTS Save Oiling Time and Labor for Secret War Plant

- Three Lubrikarts are used each carrying 6 lubricants.
- Two men operate each Lubrikart.
- Each Lubrikart is on the move only 6 hours out of every twenty-four.
- Lubrikart operators spend about 50% of their time cleaning coolant tanks and blending cutting oils . . . a doubling up of manpower.
- Due to cleanliness, simplicity, and ease of Lubrikart lubrication, and the speed with which it can be learned, this plant is considering using women for oilers.
- "Barrel to Bearing" transfer of lubricants eliminates the possibility of contamination.
- This plant reports no bearing failure to date due to faulty lubrication.

Never has dependable lubrication been so vital as it is today. Bearing failure means a "slow up" of needed war production. Faulty lubrication may ruin irreplaceable machines. That's why you should have complete information about the Alemite Lubrikart. Write for details, today.

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*Industrial* **LUBRICATION**

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## How DEVOPAKE hides and covers any surface *in just one coat!*

And it *is* fascinating to see just what Devopake does to *any* interior wall surface. It *hides solidly* in *one* coat . . . it assures good seeing conditions because it provides maximum reflection and diffusion of available light.

Alert maintenance men choose Devopake because it saves time *and* money. The *spreading quality* of Devopake cuts gallonage; application time is lessened by its *big brush workability.* Because it's a *self-sealing primer and finish coat all in one* the usual preliminary undercoating is eliminated. Man hours, vital during war times, are saved.

Devopake is an *oil-base* paint. You can depend on it to give walls the utmost protection . . . condition them to withstand repeated washings. Today Devopake is manufactured in 7 practical colors.

***Our strong claims for Devopake are fully substantiated by our customers' experiences. Discover for yourself the many advantages of this outstanding Devoe paint.***

# DEVOE PAINTS

*The 189th Year of the Oldest Paint Maker in America*

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total of women in war uniforms has been brought to more than 27,765. They all have volunteered for service anywhere for the duration. Women are under no compulsion to serve in the armed forces, but increased emphasis is being placed on recruiting women for the armed services so that more men may be released for active duty. National Selective Service is lending its support to recruiting women and in February of this year commenced interviewing those interested in obtaining information about the women's armed services at employment and selective service offices throughout Canada.

The war emergency training program of the federal Department of Labor, inaugurated in July, 1940, had enrolled 32,42[illegible] women by the end of April, 1943. More than 24,529 had completed training.

Taking the initial step in providing care for the children of women in industry, the Dominion government obtained authority July, 1942, to establish child-care facilities in any province, where requested, on a dominion-provincial equal-cost basis.

Under the agreement, provincial ministers of public welfare establish provincial advisory committees which, in turn, establish local committees in any localities where projects are to be operated. The initiative for providing child care under the agreement lies with the province, and to date eighteen wartime day nurseries have been approved.

Also, sixteen school projects have been approved under the dominion-provincial plan for the day care of school-age children.

Women volunteers provide the major part of the staffs for the child care projects and more than 300 have been trained in Toronto alone.

•

## Hand Tools Available for War Workers

Employees of plants engaged in war work may now purchase mechanics' hand service tools by using the priority rating made available to their employers through CMP Regulation 5, Direction 9, dated July 9, 1943.

Direction issued pursuant to the regulation states that an employer is permitted to buy hand tools for his employees in the following cases: (1) Where the tools will belong to the employer and are only checked out to the employee; (2) where the tools will be resold by the employer to the employee.

Where the employer is unwilling or unable to use one of these two methods, the employee is not permitted to use a preference rating under the regulation since he is not in business. This direction is issued to provide a way for employees themselves to get hand tools on their employer's ratings.

The employee of any person producing any product or conducting any business listed on Schedule I or Schedule II of CMP Regulation No. 5 may use the preference rating assigned by the regulation to his employer to purchase hand tools (including gages and engineering instruments)

# DON'T SCRAP that AIRCO Tip!

## Let an Airco Repair Station recondition it for you

Here's a typical result of Airco Repair. The tip at left—battered, nicked, and choked with carbon—was made good as new by skillful repairs.

Copper is one of the most critical materials. It must be conserved.

Here is one way to do it — don't discard a worn Airco welding or cutting tip until you've made certain it cannot be reclaimed. Send all your damaged Airco tips to us. Our skilled repair men will inspect them thoroughly and put them back into first-class working order . . . unless they're beyond repair.

In this way Airco can help you reclaim many tips that would otherwise end up in the scrap-box. So see that all old Airco tips are collected now and forward them to the nearest Air Reduction office.

Buy United States War Bonds

# Air Reduction

General Offices: 60 EAST 42nd ST., NEW YORK, 17, N.Y.

IN TEXAS: MAGNOLIA-AIRCO GAS PRODUCTS CO.

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IDLE CYLINDERS ARE PRODUCTION SLACKERS: *Keep 'em rolling for victory!*

# Ask for this book

Tells you how to take care of small tools-Bolt Clippers, Files, Taps, Drills, etc. The boiled down facts to help you get the most out of these tools-use, wear, repair and selection. Handy pocket size. Just ask on a post card for- Porter's Tool Maintenance Book it's FREE

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**PORTER CUTTERS**

BOLT CLIPPERS — AUTOBODY REPAIR TOOLS — PRUNERS

H. K. PORTER, INC., 403 ASHLAND ST., EVERETT, MASS.


which he requires for use exclusively in his employer's business and which his employer requires him to furnish.

The rating will be valid only if the employee gives the seller of the tool the prescribed purchase certificate, filled out and signed by his employer, and signed also by himself. Only one tool may be placed on each certificate with type and size of tool specified. The employee must certify that he does not possess any similar tool which would serve the same purpose.

The cost of hand tools bought by an employee by use of the preference rating must be included by the employer in computing the quantity restrictions of paragraph (f) of the regulation, but the employer may not include the cost of hand tools bought by employees during the base period for the purpose of computing his quota under paragraph (f) of the same regulation.

•

## Women Workers to Have Standard Foot Protection

With 4,000,000 women now working in war plants and an estimated 6,000,000 needed by the end of 1943 to meet production goals, the need to replace women's flimsy, toeless shoes of the playshoe variety with protective safety shoes is urgent.

Four standards for women's safety shoes have been completed by the American Standards Association under the chairmanship of Major E. R. Granniss, CMP, chief, Accident Prevention Section, Office of the Provost Marshal General, U. S. War Department, at the request of the War Production Board and the Office of Price Administration. A safety-toe oxford with steel toe-box, lighter in weight than a man's safety shoe, has been approved for general on-the-job wear to protect the worker from an impact force.

Since no single type of safety shoe for women will meet all conditions, three additional standards have been approved. The safety-toe high shoe affords ankle-high coverage for use in welders' and other industrial occupations. Explosives-operations non-sparking shoes protect the wearer and plant against sparking hazards. Women's conductive shoes minimize hazards to workers and property from electricity accumulated in the bodies of workers.

The two latter types of shoes can be built with or without the safety toe-box specified in the first standard because they may often be required to withstand electrical hazards under conditions requiring no additional protection.

In addition to the identification appearing on one shoe of each pair, listing ASA name for the shoe, indication of method of construction, and type designation, tongues of different colors have been agreed on to differentiate types of shoes. The Ordnance Department has approved use of a brown tip with black shoes or black tip with brown shoes for identification of non-sparking shoes, and use of a white tongue as identification of conductive shoes.

# IT'S NEW... IT'S YOURS... FREE!

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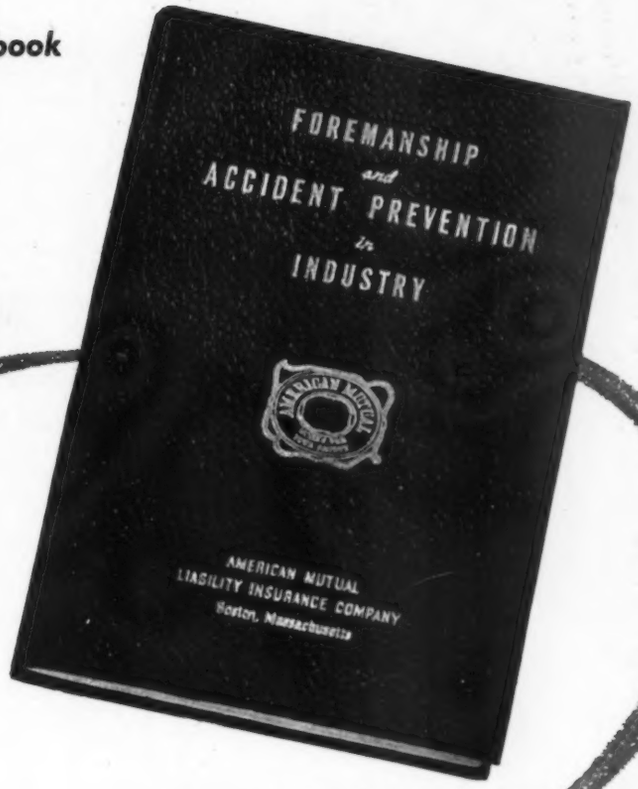


***94 pages of safety sense that will help you Select and Develop Good Foreman Material. Prevent Plant Accidents. Be a Better Foreman Yourself.***

Now! A book that does for *industry* what American Mutual's notable "Foremanship and Accident Prevention in Construction" did for the contracting business.

What's the most important thing a good foreman needs to know?

What are the chief causes of plant accidents?

What are the necessary qualifications for a good foreman?

What special problems do "women in industry" give the foreman?

What are the essentials of good safety clothing?

**94 PAGES OF PRACTICAL EXPOSITION**

*on the principles of accident prevention and their application as developed by American Mutual Engineers during 56 years of protecting industry*

**Chapter 1.** Blueprint of the good foreman and his job.

**Chapter 2.** The causes of accidents.

**Chapter 3.** Controlling accident hazards in the plant. A chart of safety clothing.

**Chapter 4.** How proper maintenance prevents accidents. And why.

**Chapter 5.** The foreman's housekeeping responsibility.

**Chapter 6.** Selecting, training, and supervising people to increase production and prevent accidents.

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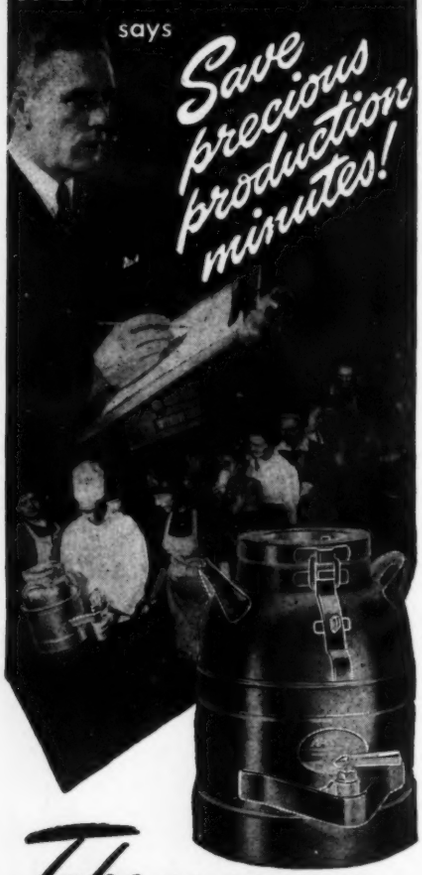


*Take* REFRESHMENT TO THE WORKERS

**Here you see illustrated a very simple and practical "bench service" that is providing hot coffee, soups and other refreshing "pick-ups" to workers in industrial war plants . . . an actual photograph taken in a war plant.**

**The outlay for equipment is negligible . . . requiring a minimum of critical materials.**

**The AerVoiD vacuum-insulated carrier makes service to workers near their work easy and simple AND SAVES VALUABLE PRODUCTION MINUTES.**

**A box, a chair, a bench or window ledge, any vacant space a few inches square, serves as a resting place for AerVoiDs while serving.**

**Indoors, outdoors, anywhere around a large plant, the easy portability of AerVoiDs makes this efficient service possible.**

**Over 100 large industrial war plants already have AerVoiDs in service. Write for new circular stating why AerVoiDs are going into war plants in constantly increasing numbers . . . in the words of users themselves.**

**Ask for circular FM-8-43**

**AERVOID all-metal vacuum-insulated Hot Food Soup and Coffee Carriers**

**VACUUM CAN COMPANY**
25 SOUTH HOYNE AVENUE
CHICAGO, ILLINOIS

# How Three War Plants Are Training Women*

TRAINING METHODS used effectively by three large producers of vital war products may be of interest to employers who are introducing women to operations for which men have habitually been employed. These plants have experienced a rapid expansion in the past six months. The need for additional workers and for replacements of skilled male employees reporting for duty with the armed forces has been met by training women. From 60 to 80 percent of their employees now are women.

## Training Policy

All three companies have well-planned training programs directed by officials charged with full responsibility for training. Although organizational structure of the training departments varies, all are closely coordinated with the personnel offices, and the training programs are geared to the needs of the production departments. Supplemental instruction courses are designed to meet the needs of specific production shops; and the production departments, in turn, supply as instructors, both on the job and in the classroom, some of their most skilled workmen. In selecting the instructors, patience and other personal qualities, as well as skill are considered.

At Plant B, a training policy board is made up of the factory manager, his assistant, the employment manager, and the supervisor of training. Meetings of the board provide for exchange of information. The training supervisor is advised through these meetings of anticipated labor requirements and hiring schedules; and the production and personnel officials are given information on the minimum training time for learning each job.

Under the direction of the training supervisor, there is a head instructor in charge of each of the three 8-hour shifts. The training department also designates a shop contact representative for each shift as its liaison officer with the production foremen. This is a unique feature of the training set-up which seems effectively to bridge the gap between departments. Training accomplishments have justified to Plant B officials the cost of maintaining their training department, which is more extensive than in most plants. Good feeling is also maintained by threshing out problems in "bull session" conferences with foremen and instructors.

## Trainee Selection

*Personal Qualifications.* Initial selection is made on the basis of personal qualifications as revealed through information on the application form and a personal interview with a personnel officer. During the interview, an effort is made to discover home responsibilities and conditions that might affect the ability of the candidate to be on the job every day.

Concern over absenteeism led personnel officers in all three plants to stress this point. Mothers with young children are discouraged from accepting employment unless they prove that there is some one in the home to care for the children. Until adequate nursery and after-school care is provided, it is not thought wise to hire workers from this group. The problems caused by absenteeism because of household responsibilities, and by child delinquency, may outweigh the contribution made to the production effort. Child-care facilities in the community are inadequate to meet the needs at the present time.

Physical examinations are a requirement, and placement in various departments is based on such qualities as eyesight, height or strength, and size of hands.

*Sources of Trainees.* Women and girls are being hired directly from the home or school, many with no previous work experience. Few of those hired since the fall of 1942 have had factory experience. Young girls from art classes are applying radium paint to instrument dials. Middle-aged women are found to be the best suited to lens grinding operations, which require constant and careful watching. In this area, labor supply is such that applicants from all and any sources are considered by personnel officers in all three plants. Orders are placed with the USES offices; students are referred from vocational training courses; and those with no special training apply at the gates. Up to the present time, the number of women applicants is adequate to meet hiring schedules.

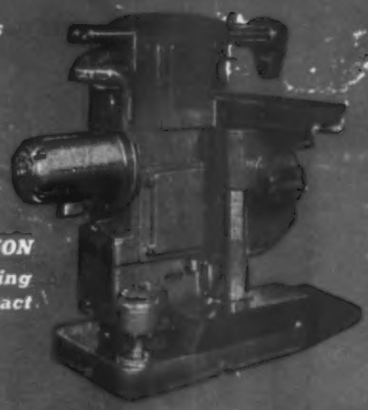
*Pre-Employment Training.* In selecting trainees, Plant B, which formerly hired only college graduates or honor graduates of vocational schools, now has no rigid educational requirements, but preference is given to candidates who have completed pre-employment training courses and to high school graduates who have had mechanical training or mathematics courses. For a few jobs, training in electrical engineering at the college level is required.

In Plant A, where applicants were formerly required to pass a formal examination, no formal examination is now given. The personnel director stated that the educational requirement now is two years of high school or its equivalent, and in many recent appointments consideration had been given to "the equivalent."

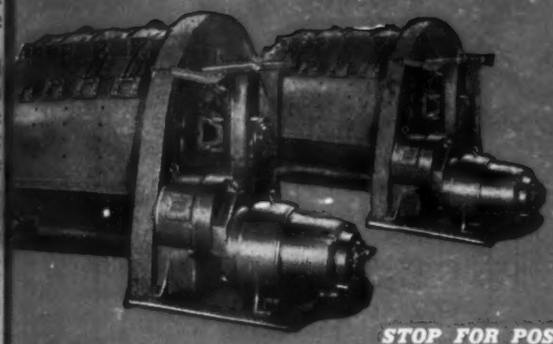
All three plants give preference to persons who have had the advantage of vocational training courses, but educational and work perience requirements have

* *From a study made by Mary Curran, Training Specialist, Apprentice Training Service, War Manpower Commission*

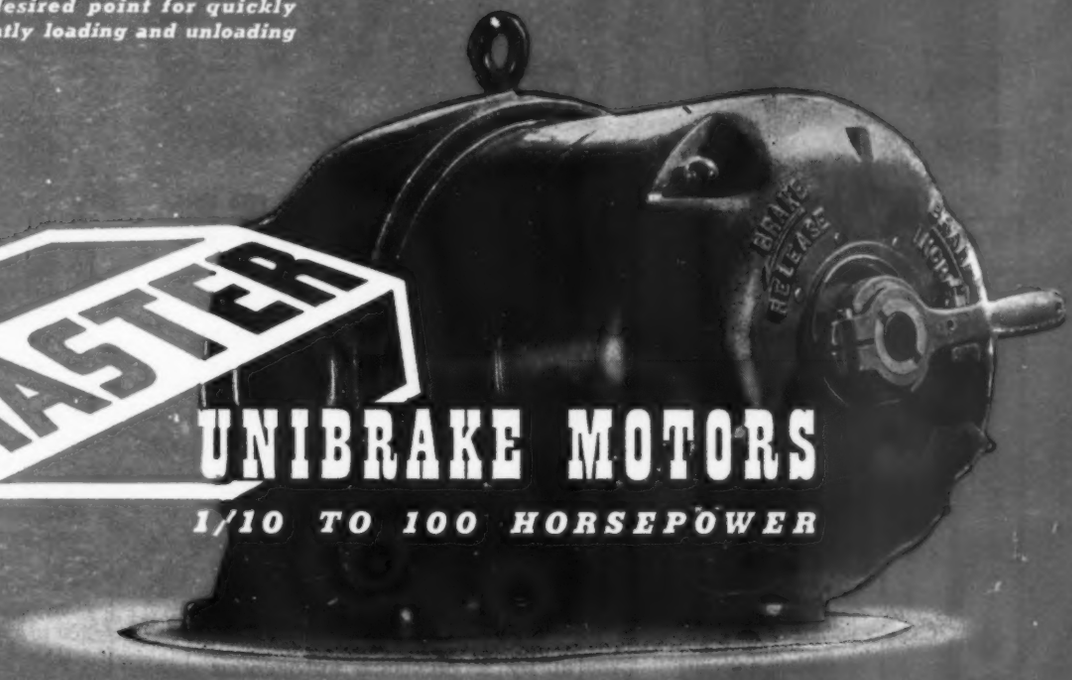
BUY UNITED STATES WAR BONDS AND STAMPS



**SPEED UP PRODUCTION**
*Save time by stopping quickly with a compact integral brake unit*



**STOP FOR POSITION**
*Stop at the desired point for quickly and conveniently loading and unloading*

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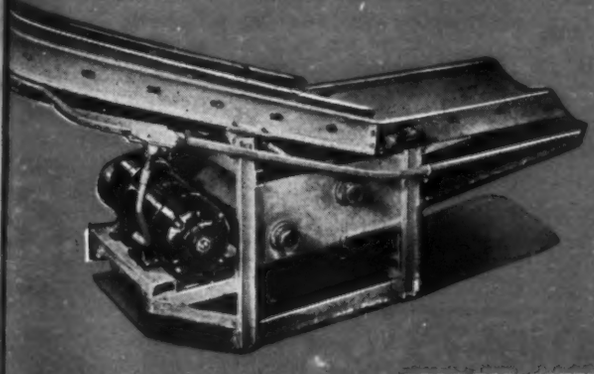

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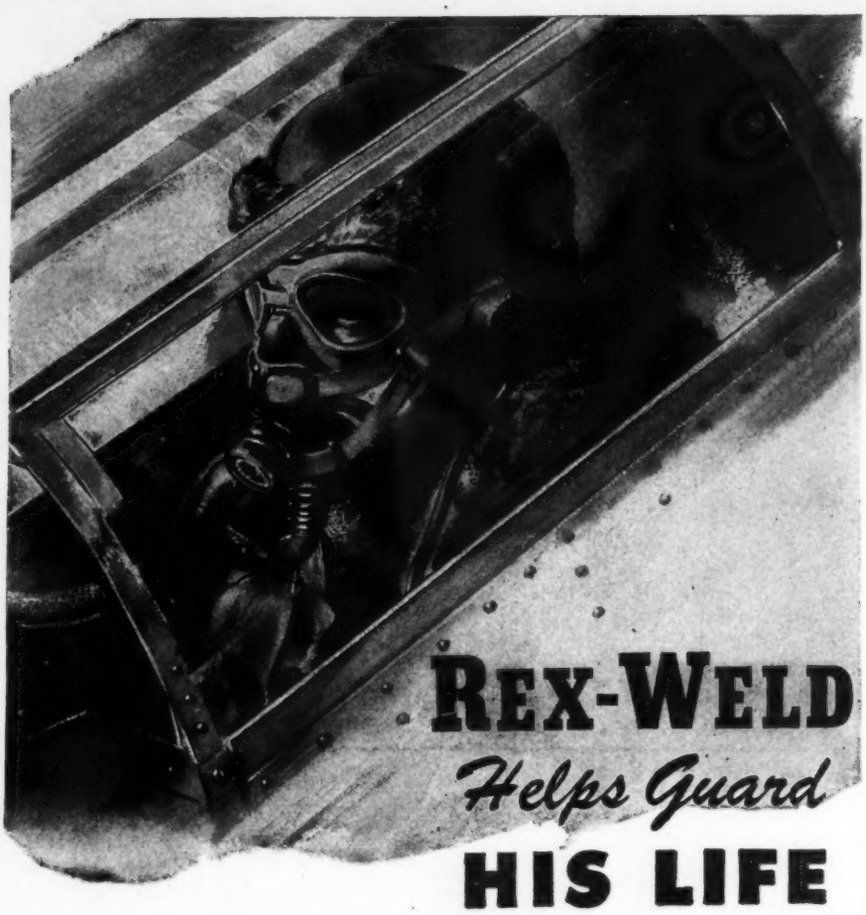
*Reduce the hazard of injury to workmen or damage to equipment which might cripple vital production*

**STOP AND HOLD ANY LOAD**
*Unibrake motors are very advantageous on hoists, elevators, inclined conveyors, etc. . . .*



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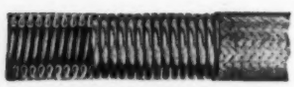

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been relaxed as the trained labor supply in this critical area has become exhausted.

### Orientation Training

Most persons are not willing to take war production training at their own expense when they can secure jobs and be paid while being trained. Therefore, individuals are hired as trainees and given pre-assignment or orientation training after being placed on the company payroll.

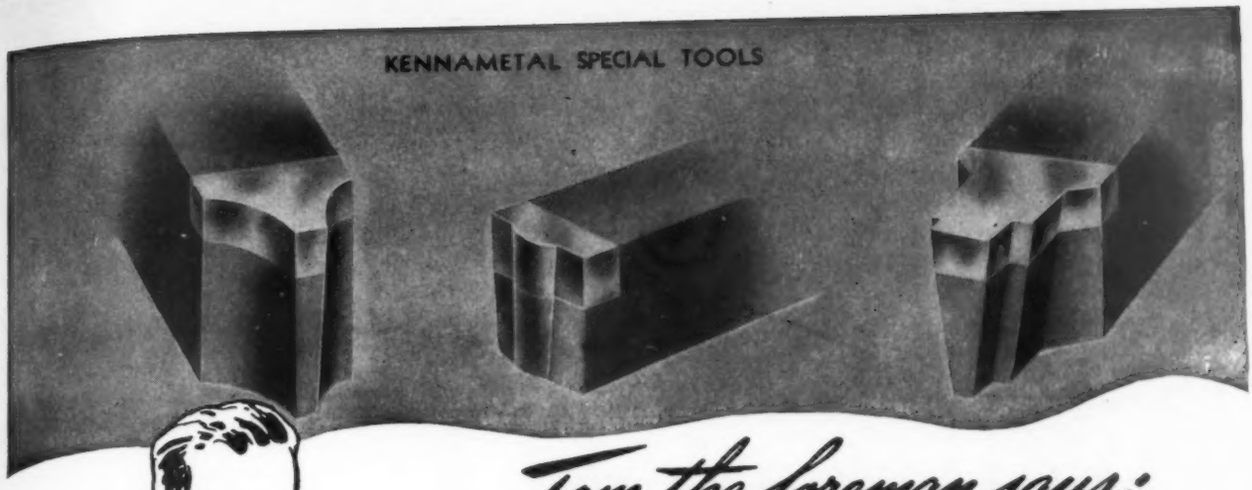
*Plant A.* A 6-week pre-assignment course is planned for all new employees. Women are selected upon hiring either as learners for the machine shop; as trainees for the lens grinding department; or as draftsmen trainees. Upon employment, the draftsmen trainees are assigned to classes in one of the public vocational schools; those selected for the lens grinding department are sent to another public school which has lens grinding equipment; one group of machine shop learners is assigned to a public vocational school especially well equipped for machine shop work; and the largest group of machine shop learners is assigned to the night shift at the plant's own training school on the grounds. All learners are paid by the company while attending these schools.

In the plant training school, all work is on production jobs, but the emphasis is on the learning process, and there is no production pressure. Trainees are at first given simple jig and fixture work. As they become oriented and develop elemental skills on the machine, they are instructed in the technique of the more complicated operations.

During the 6-week training period, supplementary classroom instruction which has a practical application to the job is given in addition to shop practice. These courses are in mathematics; blueprint reading; reading of micrometers, gages, and other measuring instruments; and safety instruction. Classroom instruction in the plant training school is given by public vocational school instructors, and by the plant safety engineer. (This school is limited to apprentices during the day shift.)

The lack of mathematical training is the greatest handicap to be overcome by the girls being trained for the machine shop, according to the foreman of the plant training school. He says that most of the girls have never learned to appreciate the usefulness of mathematics. During their training period, those with a talent for mathematics and a mechanical aptitude are spotted for assignment to the toolrooms, according to physical qualities and temperamental characteristics observed during the training period. Others are assigned to assembly work, simple testing, drill presses. Out of the group of trainees to date, it has been possible to select girls who do good work on lathes and milling machines, and these girls can follow simple blueprints. Some will learn to do their own set-up work.

Upon completion of the training course or upon demand for trainees by a production department, selection from the groups of trainees attending public vocational school classes, for assignment to a particular section or department, is based



*Tom the foreman says:*

**"IT COSTS TOO MUCH TO MAKE SPECIALS FROM STANDARDS"**

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"For quite some time we ground down standard carbide tools to shapes for special steel-cutting jobs. This system worked out all right for one or two tools but was too expensive on repeated operations which used several tools of the same shape.

"We were wasting machinists' time which should have been spent in production. Critical material was lost in the grinding process. If we continued to make our own tools for these special jobs we would have to install expensive equipment to insure accurate tool conversion and like most steel-machining plants we weren't converting enough tools to make this machinery pay for itself.

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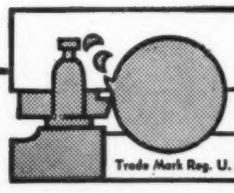

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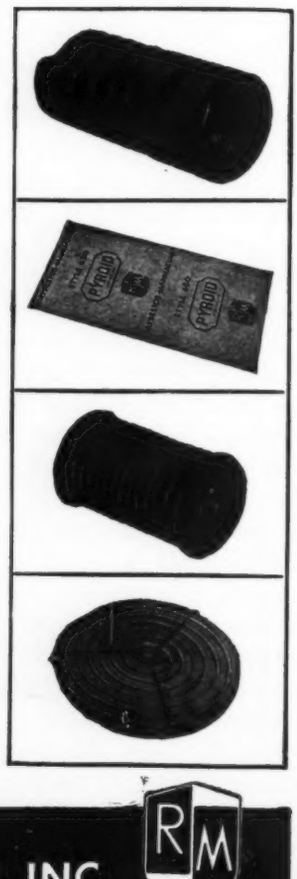


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upon the school record, observation of aptitudes by the instructor, and physical fitness such as eyesight, steady nerves, or physical strength for the heavier jobs. Between June, 1942 and January, 1943, women trainees have been placed in every department except the crating department, where the work requires lifting of heavy packing boxes.

A strong determining factor in the length of the pre-assignment training period in this plant at the present time is the need of the production department for workers. Where the demand for workers cannot be met by trainees, persons are placed directly in a production department and given instruction on the job or are taken from the schools before completing the course.

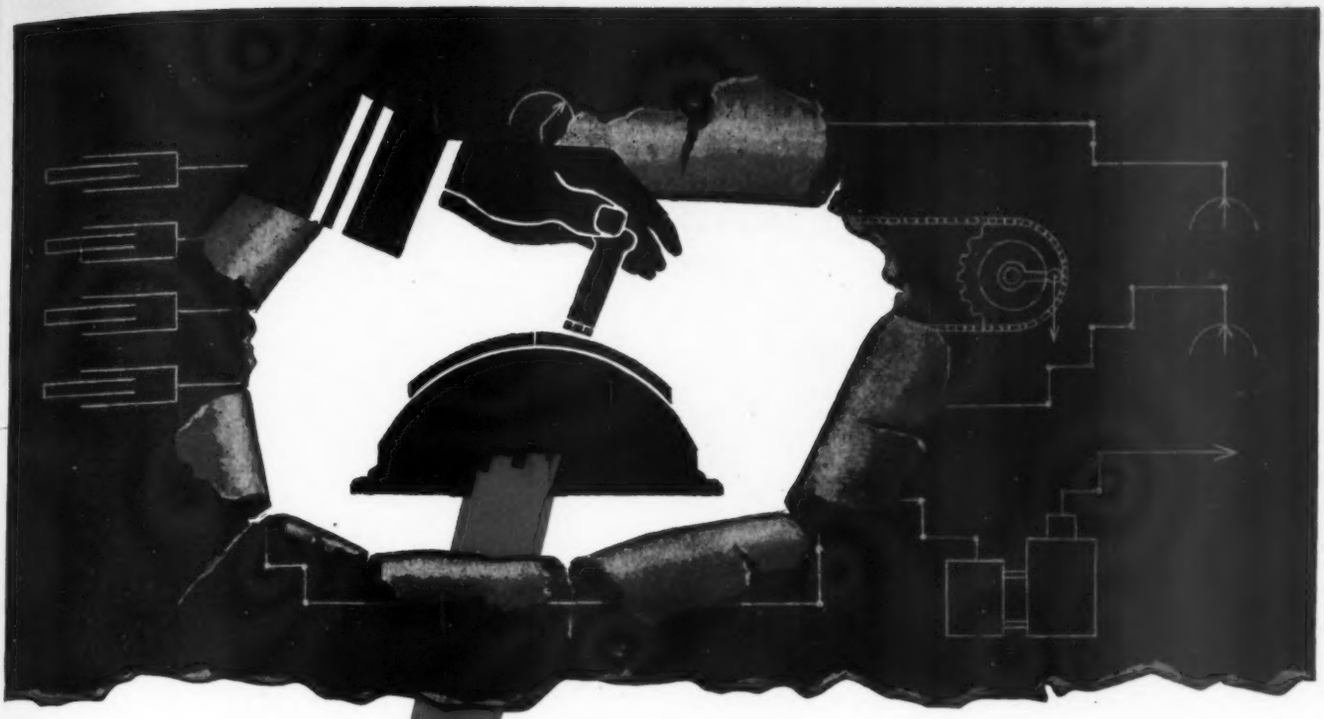
During the last seven months of 1942, 87 percent of the learners hired by the plant were female.

*Plant B.* All trainees hired are given one week of pre-production training before assignment to a work station in the plant. Upon hiring, a learner assignment form is sent from the employment department to the training department. Suggested courses for the trainees are blueprint, shop mathematics, measurement, fits and finishes, shop practice, and elementary instrument assembly. Detailed manuals made up by the training department are the textbooks, and a technical lending library is maintained. The latter is widely used by the employees.

The elementary course in instrument assembly is an over-all study of the principles of operation of flight instruments and their relationship to "flight security." The importance of the industry to the war effort and the necessity for quality workmanship are pointed out, and each tool and operation is carefully explained and illustrated. Thus trainees are made conscious of the relationship of the part to the whole and of their particular contribution to the war production program. Blueprints and analysis sheets and their uses, as well as such terms as allowances, tolerances, and dynamic balance, are fully and simply explained.

Trainees are assigned to classes by the instructor in charge. Instructors are selected by the training director from the best qualified workmen in the production departments. They are trained in instruction methods. The trainees spend one hour a day in each of the classes to which they are assigned. In addition, they are given talks by the safety engineer, trips through the entire plant, and practical instruction on machine tools and in inspection procedures. The training supervisor expressed the opinion that this orientation training is of special importance for women trainees, since their acquaintanceship with production shops is negligible.

*Plant C.* After trainees are selected from applicants referred by USES, from the vocational schools, or elsewhere, no training is given in the plant prior to an on-the-job assignment. The personnel officer who directs the training program assigns trainees immediately to a work station in a production department. Starting jobs are



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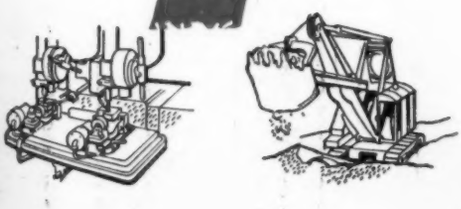

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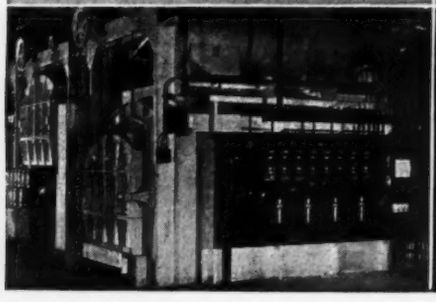

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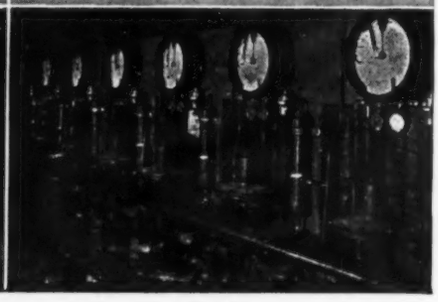



usually assembly work or drill press operations. The job instructor is expected to assist the new employee to become oriented in his job.

### Training on the Job

*Plant A.* The optical section of the instrument department has absorbed the largest number of female trainees hired in the past seven months. Women have been found to be especially well fitted for this work as it is light work requiring patience, a sense of touch, and precision. Assignment to a particular work station is on the basis of the aptitude shown at the school and on the recommendation of the instructor.

Under present conditions, the assignment is, of course, also affected by the needs of the production department. Women perform every operation from rough grinding to centering, inspection and some of the last stages of polishing. In the finer grinding operations, middle-aged women are preferred to young girls since this process requires steady and careful watching. Final prism inspection and hand inspection are still being done by men, but it is expected that with experience in developing "feel," and training to a higher degree of precision, some of the women will be able to perform these jobs when necessary.

In the lathe shop of the instrument department, the foreman was enthusiastic about what the girls were doing. There are 55 girls on the night shift. Since the work in his department is heavy and difficult to set up, experienced men are used on the day shift to get the work set up and going. The girls come in for an overlap of about 15 minutes so that the men can explain the set-up and the job they are to do.

Of this group of 55 trainees, none of whom had had more than six months' experience, including the pre-production training, 14 had been recommended for promotion to machine operators. He intends to try a few of these operators on set-up work. This foreman remarked that the girls were particularly good on the drills, as compared with the men, as they had a better sense of touch on the tapping. On-the-job training continues in the production department until the "trainee" is promoted to "operator."

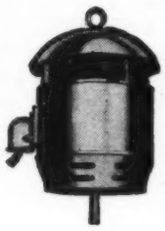
*Plant B.* Requests for learners originate with the department foreman and the production superintendent, and then are sent to the training department. Although the trainees remain in pre-assignment training until a request is received by the training department from a production department, with the present demand for workers the minimum of one week is almost of the trainees spend in pre-assignment classes.

From the trainees who have completed the one week of orientation training, the instructor recommends those whom he considers best qualified for the positions which are open. Training on the job continues to be directed by the training department in cooperation with the production department foreman. There is close coordination between the training depart-

# FLANGED END HEADS SIMPLIFY Vertical MOUNTINGS OF R&M Uni-Shell INTEGRAL HORSEPOWER MOTORS

## VERTICAL MOTORS WITH DRIP-PROOF COVERS

Vertical *Uni-Shell* Motors with drip-proof cover and special base. A wide variety of flanged end heads, ring, and tripod bases are available.



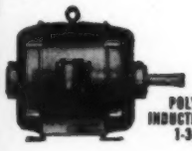
The vertical D. C. motor is made drip-proof with special end head covers. All flanged heads or lower bases developed for other types are available for D. C. frames.

Vertical type of capacitor-start induction run motor with drip cover and external capacitors. All flanged heads are completely interchangeable for all motor types.

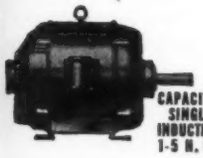
All of the motors shown above use the same flanged head, but many other flanges, standard and special, can be supplied. It is important to remember that such heads are interchangeable for Single-Phase D.C. and Polyphase motors.

### ONLY END HEADS CHANGE

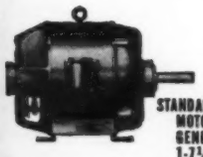
Every dimension, from Uni-Shell motor body to head fit, is identical for all motor types.



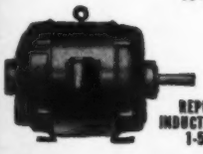
POLYPHASE INDUCTION MOTOR 1-30 H. P.



CAPACITOR-START SINGLE-PHASE INDUCTION MOTOR 1-5 H. P.



STANDARD D. C. MOTOR AND GENERATOR 1-7½ H. P. ¾-5 K. W.



REPULSION INDUCTION MOTOR 1-5 H. P.

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The R & M Uni-Shell Motor represents the development of a revolutionary idea in electric motor design. In all types of Uni-Shell motors, the shell length, diameter, base mounting holes, shaft dimensions, height of shaft above base, head fit and bolt circle mounting for heads are exactly the same for any frame size. Only the end opposite the shaft extension varies from one type to another and then with only a slight change in external appearance.

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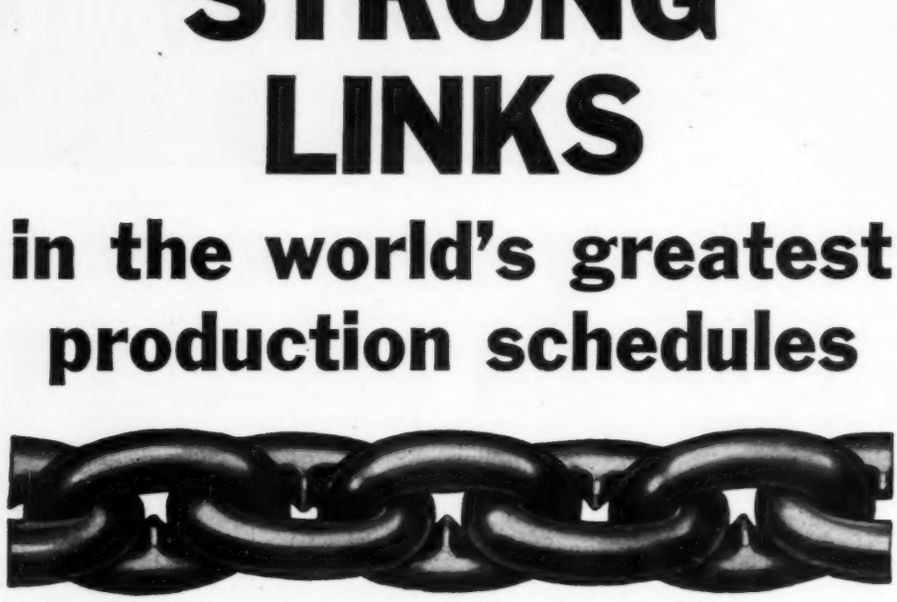

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ment and the production departmen through a series of notification forms a through shop contact representatives fro the training department. The training partment keeps records of the courses co pleted and grades received by each in vidual in the plant, and a record of t rate increases of each trainee.

After the trainee is assigned to a depa ment, a shop contact representative of t training department discusses with t foreman the supplementary courses t trainee should take in order to acqui the knowledge necessary to qualify for t job classification for which she is trainin On the basis of this information, a sche ule is made up by the training departmen and each foreman is notified which lear ers are to attend which classes. The might be blueprint reading, measuring i strument reading, mathematics, or oth subjects directly related to the job.

Most of the work at Plant B is on sma parts, and women have been foun especially adept at handling them. On t instrument drill press they are doing be ter than men. The training supervis stated that the amount of scrap was le than one would expect and attributed to the careful training the learners a receiving.

### Careful Supervision

One girl has been assigned to an Excell grinder where a small part must be in serted while a very sharp wheel is revolvin continuously. One moment of carelessnes here in not inserting it in just the righ way might mean the loss of a finger. A operator instructor was assigned to teac this operation. The trainee observed th instructor performing the operation fo the first few hours. She was then shown exactly how the piece was inserted, r peated the motions after the instructo and then was allowed to do it under th watchful eye of the instructor. After cor rection and repetition of the observing an trying process, the operation was mastered Careful training prevented an accident dur ing the learning period. Girls are learning to operate most of the machines. On th Excello boring machine, they cut t 0.0002.

Girls are adept in the assembly of the small parts and wiring that make up the instruments for airplane panel boards. Al the employees in the coil-winding depart ment are women; in order to relieve the monotony of this work, recorded music i provided through amplifiers.

Girls are now operating Brown & Sharpe machines, doing set-up work on particular production items, handling taps, and sharp ening the tools. As might be expected, the are not so fast in this work as the boy graduates from the vocational schools, cus tomarily hired for these jobs, but they are doing well.

A device to make the work more inter esting is the use of showcases with in struments mounted and open on one side so that the inside parts could be seen Workers are encouraged to find the par ticular part on which they are working and see its relationship to the whole. This heightens the interest of each worker in his own small part in supplying our armed

# ELECTRONIC DEVICE "3C" *Applicationeered*

¶ "3C" Engineers are alert to the advantages of Electronics in electrical control problems.

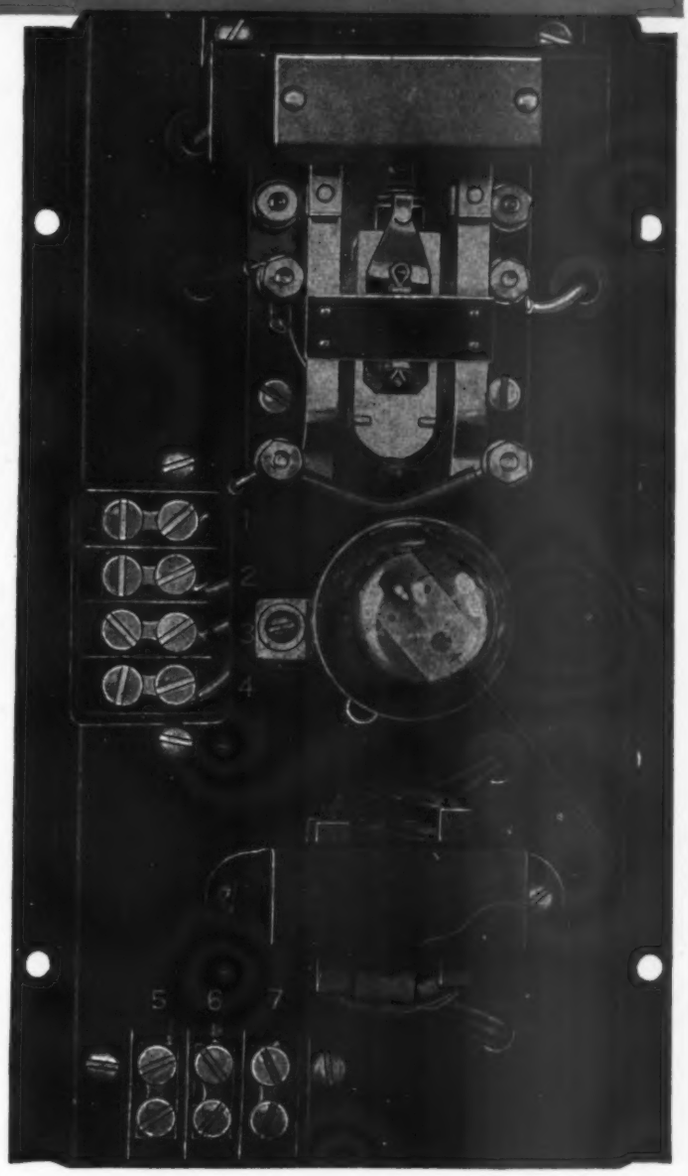
¶ Two Electronic devices—"3C" Bulletin 7313 Type ET Electronic Time Delay Relay, and "3C" Bulletin 7744 Weldmaster Timers for A. C. Resistance Welders—have been delivering excellent service in hundreds of war plants.

¶ Pictured is a special new Electronic Timer—simple in construction, and using only one tube.

¶ It is specially designed and built to time the travel of cross-feed on hydraulic feed in a Surface Grinder machine application.

¶ It has a time range of 1/10 to 1 second and is designed for 40 operations per minute, 24 hours a day—an extremely severe duty cycle.

¶ This Electronic Timer is built-in the machine—occupies minimum area—but allows plenty of wiring space. The Relay used is small but very rugged, to give millions of operations with minimum maintenance. All other devices used are not movable parts, are not affected by frequent operation, hence have exceptional trouble-free long life.




¶ This is a typical "3C" Application-engineered job, designed to do one operation only. It is not available in this particular form for any other application.

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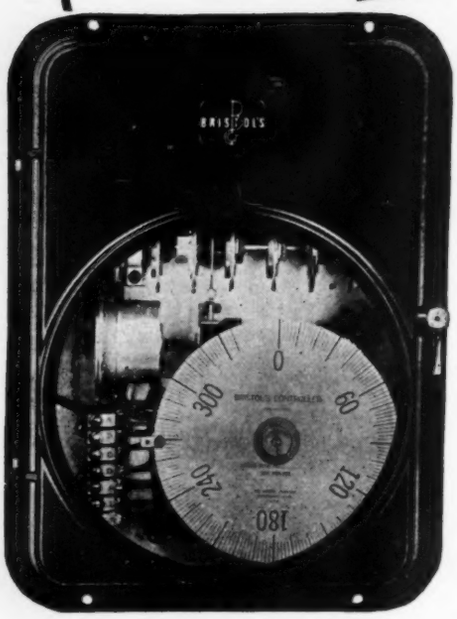

The Bristol Company, Waterbury, Connecticut, a leading instrument manufacturer, finds numerous uses for LEA Methods and LEA Materials for burring and finishing. As the manufacturers put it, "while our product is so specialized that it does not readily lend itself to production line methods, LEA Methods and Materials are used on many small parts and assemblies that need polishing or burring. The most extensive use is made in preparing parts for plating."

We don't claim that LEA Methods and LEA Materials are a cure-all for all burring, polishing and buffing problems, but we do know they have solved successfully thousands of such problems . . . producing cleaner, more precise parts at lower cost than had been possible in other ways. Their versatility is well exemplified by the work done in connection with Bristol Instruments.

Why not check up on your burring and finishing operations? If results don't seem satisfactory or if costs seem too high, discuss the problem with us.

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forces. These "cut-away" products are also used as illustrations during classroom instruction.

*Plant C.* Women have customarily made up 50 percent of the personnel of this plant, but a 300 percent expansion during the past 9 months has forced the company to train women in operations previously performed exclusively by men. Starting jobs are usually on assembly work or on the hand drill presses. A job instructor teaches the trainee the specific operations required at that work station. Those showing machine aptitude are advanced to hand screw machines and then to automatic screw machines. Thirty-three girls are now doing good work as automatic screw machine operators.

In advancing workers to more responsible positions, most consideration is given to those employees who have demonstrated their interest in advancement through taking the voluntary supplemental instruction courses offered outside of working hours in conjunction with a nearby university. Some of these courses are given by instructors from the plant and are designed to meet the plant needs for better trained workers. Inspection courses are offered both to employees interested in advancing to inspection work and to some new employees hired especially for this kind of work.

### Foreman Reluctance

In Plant A, the foreman of the milling section of the instrument department was strongly opposed to having any women in his shop and only a short time ago consented to try one out. One of the best girl trainees from the plant training school from the standpoint of ability and temperament was sent to him, and he grudgingly admitted, after trial, that she was a fine worker.

Although he still has his personal reservations about women in his shop, he says the six he now has are doing all right. Their production record is good. In this work, surface finger cuts are common among the men. From his remarks about cut fingers, the impression was gained that his aversion to girls in his shop was based to some extent on his dislike of even minor injuries to their hands.

The foreman of the automatic screw machine department in Plant C was opposed to having girls in his department. He consented to try a few of the best operators on the hand screw machines. Their success is evidenced by the fact that there are 33 girls now in the department. One of these girls is now being taught set-up.

Loss of indentured toolroom apprentices to the military services led officials at Plant C to consider girl toolmaker apprentices. The foreman of the toolroom, when first approached on the subject, threatened to quit if a woman crossed the threshold of the tool shop. However, he has now consented to experiment with one girl who has been with the company for eight years. She will be placed under indenture and given credit for applicable

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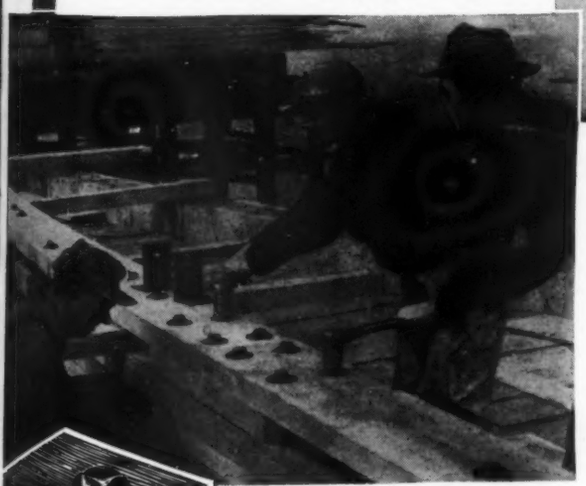

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work experience. The apprenticeship program is registered with the State Apprenticeship Council.

### Women as Supervisors

To assist the foremen at Plant C and to replace those lost to the services and other war production plants, one foreman is being placed in charge of from four to six assembly lines, and a woman supervisor will be in charge of each line, working under him. Supervisors are selected from a group for their judgment and general ability to get along with the girls. This arrangement is working out satisfactorily. In the opinion of the personnel director, women can be trained to be effective as foremen and show less partiality to individual girls than the male foremen. Twenty-two girls are taking the supervisor course, and 12 are enrolled in the 4-week foreman training course.

Officials at the other two plants do not believe that women make good foremen. Their objections, based purely on opinion and not on experience, are that women foremen would be inclined to pay too much attention to small details and to be dictatorial.

Women counselors are employed in the personnel departments. Their duties are to advise the girls on personal problems.

### Working Hours

At Plant B, all production departments operate on three shifts. The women, much to the surprise of the personnel department, prefer the second and third shifts. No analysis of the reason has been made. Contributing factors may be because they can do their shopping, household, and personal duties during the daytime. All employees are on a 48-hour, 6-day week in this plant.

At Plant A, the training school is operated on two shifts, with the female machine shop learners all on the night shift. During the day shift, the school is used for the training of male apprentices in their first and second years. The girls and boys were not segregated at first, but the training supervisor explained that since these groups are made up, for the most part, of young boys and girls, there are fewer problems and less horseplay when they are separated. Women are also assigned to the night shift in the lathe shop of the instrument department so that the experienced men can set up the jobs. In other departments, men and women prefer to work on the day shift.

Plant C works on two shifts with fewer employees on the night shift. The girls rotate on the night shift since there is a decided preference for the day shift.

### Absenteeism

One of the major problems in all three plants is that of absenteeism, which has risen noticeably with plant expansion and the hiring of young and green workers. So far as it applies to women, this is attributed to various causes, including home responsibilities, shopping difficulties, and the fact that many of the women are out of the home or school and have, therefore,

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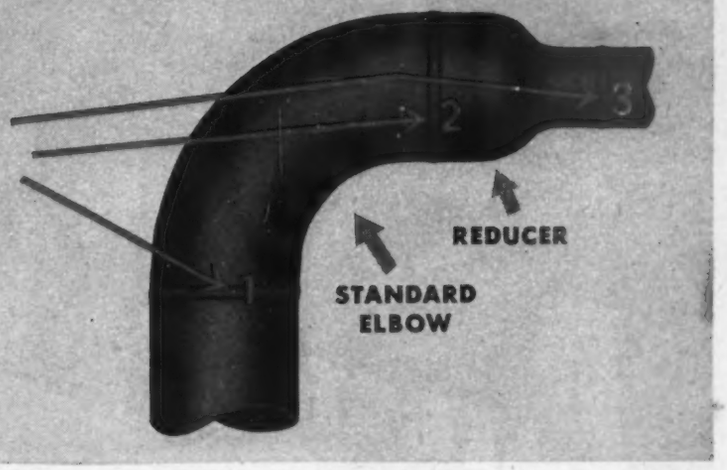

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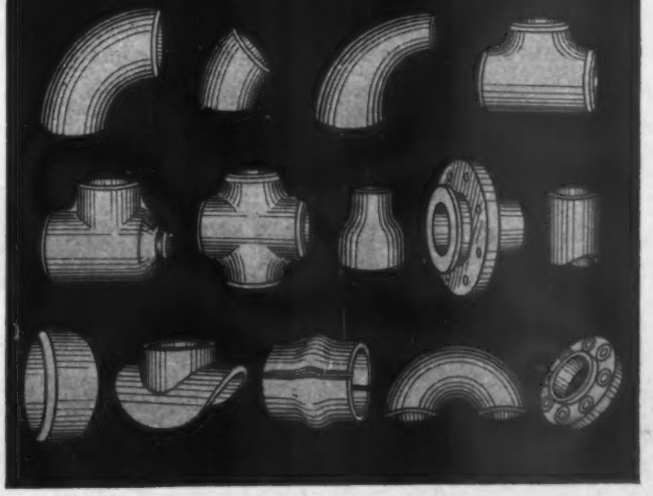

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not established steady work habits. One of the foremen remarked that although the women are absent more, they apply themselves more diligently while on the job than did the men, and, therefore, their production records are good.

The absences complained of are for reasons other than sickness. Permissive vacations are out for the duration. Therefore, employees do not ask for leave but simply stay out when they feel the necessity. Various methods are being tried to overcome this. At Plant C, the personnel department is trying out a regulation that for all non-permissive or unexplained absences the worker must report to the personnel office to explain his absence before reporting to the foreman for work.

### Safety and Clothing

Safety instruction is given strong and continual emphasis throughout the training periods in all of these plants. By insisting on safety practices, accidents have been avoided. Careful induction training has reduced the number of cut fingers.

In one reception room, there is a sign which states that one need not apply unless interested in being careful. All plants require that the girls working on the machines wear hairnets. They have tried influencing the girls to wear uniform slacks by having the lead girls and supervisors try them, but so far this has not been noticeably successful.

Plant B furnishes smocks for non-machine work and coveralls to employees doing machine work. It is required that these be worn. In an air-conditioned room at Plant B, art students apply radium paint to instrument dials. Rigid rulings forbid the use of make-up and nail polish. Every precaution is taken to prevent radium poisoning. All employees of the department are given physical examinations periodically, and several times a day they are examined by women supervisors in a dark booth for any particles that might cling to their clothes. In spite of these regulations, this is a popular department with the girls.

At Plant A, all rings must be removed. In departments in which there are moving machines, safety clothing must be worn. This consists of slacks; a blouse or sweater not loose, and tucked in, with short sleeves; hairnet; and safety shoes. A safety clothing store has recently been set up. Attractively designed slacks, blouses, smocks, and safety shoes are offered to employees at a reduced price on a strictly non-profit basis. The store is open at hours to accommodate workers on all shifts.

The training directors are emphatic in the opinion that orientation training is of importance for women trainees, since their acquaintanceship with production shops is negligible. They recommend that it be as complete as demands from the departments for replacements will permit. Anticipation of labor requirements will assist in planning the hiring so that each trainee will get the benefit of the full orientation course. To make effective workers of the women, the orientation training should be followed up with training on the job, with pertinent supplementary instruction.

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### READING BLUEPRINTS IN THE MACHINE INDUSTRIES

Carlton Dwight, B. S., instructor, vocational department, Central and North High Schools, Binghamton, N. Y., McGraw-Hill Book Co., 330 W. 42nd St., New York. 144 pages. Drawings, tables, figures, index. $1.75.

To read a drawing accurately is being increasingly emphasized as a skill essential to successful employment in many occupations in the machine industries. This text is intended to be complete within itself from the standpoint of both instructional material and projects. Each unit of instruction is accompanied by adequate projects or questions to determine the student's understanding of the topic which has been presented.

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PRACTICAL METHODS OF SPEEDING PRODUCTION. The outlook, scheduling, small tools. L. C. Morrow, editor, Factory; James G. Moore, Thompson Aircraft Products Co.; Edwin Roth, American Type Founders. Production Series No. 143. American Management Assn., 330 W. 42nd St., New York. 27 pages. 50c.

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NEW MANPOWER THROUGH BETTER UTILIZATION. Frank H. Sparks, Bureau of Manpower Utilization; R. D. Mansfield, Fortsmann Woolen Company; Russell I. Greenly, Carnegie-Illinois Street Corporation; S. E. Dyke, Armstrong Cork Company. Production Series No. 144. American Management Assn., 330 W. 42nd St., New York. 28 pages. 50c.

PLANNING AND ORGANIZING A MORALE PROGRAM. Policy Holders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York. 17 pages. Photographs. No charge.

THE USE OF PART-TIME WORKERS IN THE WAR EFFORT. Helen Baker, assistant director, Rita B. Friedman, research assistant, Industrial Relations Section, Princeton University. Department of Economics and Social Institutions, Princeton University, Princeton, N. J. 48 pages. Bibliography. $1.

OPERATING UNDER CMP. Harold Boeschenstein, War Production Board; Walter Skuce, War Production Board; E. N. Osterberg, Stewart-Warner Corp.; Kenneth Andersen, National Electrical Manufacturers Association. Production Series No. 145. American Management Assn., 33 W. 42nd St., New York. 27 pages. 50c.

THE FOREMAN. The key man in your plant. National Association of Manufacturers, 14 W. 49th St., New York. 16 pages. Prices on request for quantities; single copies, no charge.

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CHOOSING WOMEN FOR WAR-INDUSTRY JOBS. Special Bulletin No. 12 of the Women's Bureau. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 10 pages. Bibliography. 5c.

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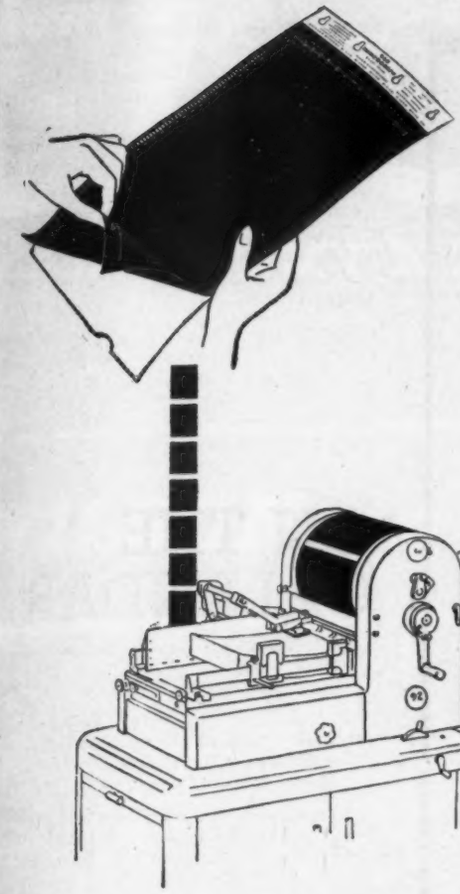

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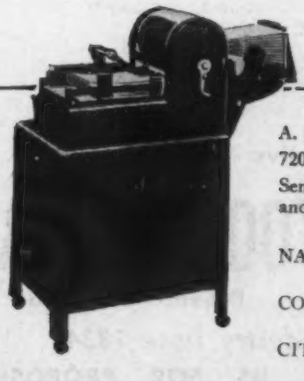

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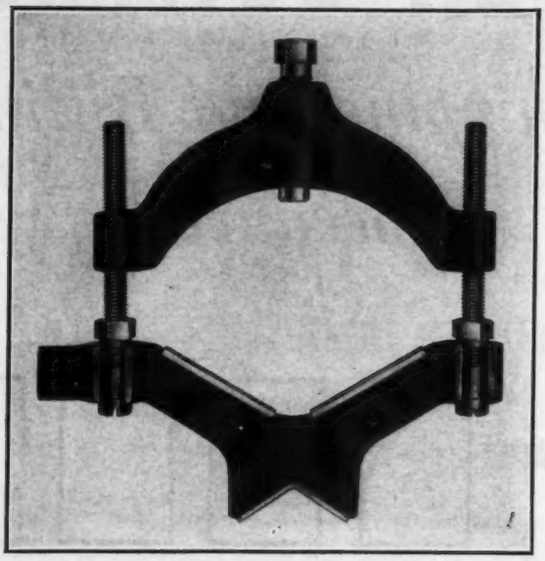

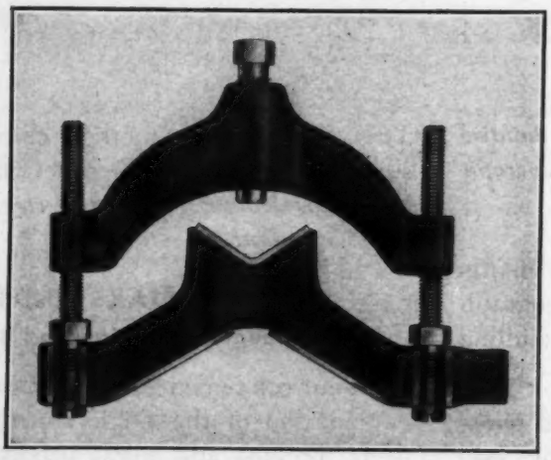

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BASIC CRITERIA OF PRICE POLICY. Chapter XI of forthcoming book "Price Making in a Democracy." Edwin G. Nourse. The Brookings Institution, Washington, D. C. 52 pages. 25c.

PACKAGING WAR MATERIEL FOR OVERSEAS SHIPMENT. A short course. G. A. Garratt, S. B. McKean, T. A. Carlson, W. A. Piper. Packaging Series No. 6. American Management Assn., 330 W. 42nd St., New York. 34 pages. 50c.

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# ON THE CALENDAR

### SEPTEMBER

2–4, American Institute of Electrical Engineers, National Technical Meeting, Salt Lake City. H. H. Henline, Secretary, 33 West 39th St., New York.

6–10, American Chemical Society, Semiannual Meeting, Minneapolis. Alden H. Emery, Assistant Manager, 155 Sixteenth St., N. W., Washington, D. C.

23, Association of Consulting Management Engineers, Inc., Meeting, New York. Nathaniel W. Barnes, Executive Secretary, 347 Madison Ave., New York.

28–30, Association of Iron & Steel Engineers, Annual Convention, Hotel William Penn, Pittsburgh. Brent Wiley, Managing Director, Empire Building, Pittsburgh.

### OCTOBER

5–7, National Safety Council, 32nd National Safety Congress and Exposition, Sherman Hotel, Chicago. Ned H. Dearborn, Executive Vice-President, National Safety Council, Inc., 20 N. Wacker Drive, Chicago.

18–21, American Welding Society, Annual Meeting, Hotel Morrison, Chicago. M. M. Kelly, Secretary, 33 W. 39th St., New York.

18–22, American Society for Metals, National Metal Congress and Exposition, Palmer House, Chicago. W. H. Eisenman, Secretary, 7301 Euclid Ave., Cleveland.

19–21, American Institute of Accountants, 56th Annual Meeting, Waldorf-Astoria Hotel, New York. John L. Carey, Secretary, 13 E. 41st St., New York.

25–29, National Electrical Manufacturers Association, Annual Meeting, Waldorf-Astoria Hotel, New York. R. J. Blair, Convention Manager, 155 E. 44th St., New York.

### INDUSTRIAL HYGIENE COURSE

October 19–21, Continued Education Course in industrial hygiene for plant safety personnel. H. E. Miller, Chairman, Planning Committee for In-Service Training Course for Plant Safety Personnel, University of Michigan, School of Public Health, Ann Arbor, Mich.